An Empirical Analysis of the Factors Affecting Appropriateness of Confidence in Predicting Financially Distressed Firms

By

Siu-yeung CHAN

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ABSTRACT

An Empirical Analysis of the Factors Affecting Appropriateness of Confidence in Predicting Financially Distressed Firms

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Confidence is a judge's estimation of the probability that his/her judgment is correct. Appropriateness of confidence is how well the judge's confidence matches the normative probability of the actual correct judgments (Griffin and Tversky, 1992). A judge is overconfident if his/her confidence is greater than the corresponding normative probability, whereas a judge is underconfident if his/her confidence is less than the corresponding normative probability. Inappropriate confidence could lead bank loan officers to commit judgment errors with serious consequences of which they would not even be aware.

The current study investigated the prediction performance of bank loan officers as measured by the appropriateness of their confidence when predicting the probabilities of firms being in financial distress. It further examined three selected major factors that could affect this performance. These factors were the relevance of base-rate information, the perceived informativeness of case-specific evidence, and the need for cognition (NC) trait of bank loan officers.

Data was gathered by individual interviews with 50 bank loan officers from the Bank of China Group who were randomly assigned to two treatment groups: the more relevant and the less relevant base-rate information groups. The study used a two-group experimental design with before and after treatment observations by dividing the experiment into two consecutive prediction tasks. In Task 1, all subjects were asked to assess the financial distress likelihood for each of the ten given corporate financial profiles containing nine financial ratios extracted from stepwise logit analysis

and executives interviews. In Task 2, the subjects in each treatment group were given a different type of additional base-rate information (either more relevant or less relevant) and were asked to assess the financial distress probability for each of the same ten given profiles. The NC trait of bank loan officers was measured by the 18-item NC instrument as being developed by Cacioppo, Petty and Kao (1984). The perceived informativeness of case-specific evidence was measured by classifying the financial distress likelihoods into either low or high informative group according to whether the evidence can clearly lead one to judge that the firms would or would not be in financial distress. Appropriateness of confidence was measured by comparing a bank loan officer's probability judgment of financial distress solicited in Task 2 of the experiment with a normative standard based on the Bayesian rule.

The t-test results indicated that bank loan officers had significant overconfidence when predicting the probabilities of firms being in financial distress. The unbalanced ANOVA test and the supplementary repeated measures ANOVA test provided moderate support that bank loan officers who were given the more relevant base-rate information had less overconfidence than those bank loan officers who were given the less relevant base-rate information. In addition, by using an unbalanced ANOVA test both with and without controlling for the effect of task predictability (i.e., the predictability of financial distress for a firm from its financial ratios), it was further found that bank loan officers who perceived case-specific evidence as being more informative had less overconfidence than those bank loan officers who perceived case-specific evidence as being less informative. However, neither the main effect of NC, nor the interaction effect between NC and the relevance of base-rate information, was found to be statistically significant. The implications of these results for theory and practice were discussed.

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CHAPTER I

INTRODUCTION

1.1 Background of the Study

Financial statements contain a wealth of useful information to unveil a firm's financial health, the success of its operations, and the insight into its future performance (Fraser, 1995). Frequently, users of financial statements need to integrate many different pieces of information from the financial statements and other sources into a probabilistic judgment. For example, bank loan officers are often required to incorporate financial ratios, the base rate of financial distress, and other financial data into a judgment for predicting the future financial soundness of a firm.

Measuring the performance of these probabilistic judgments is important for understanding how well bank loan officers make these judgments and how to improve their judgment performance. This measure is also important for a bank loan officer to evaluate the quality of each judgment source and to consolidate the different sources into a final lending decision effectively. For these reasons, the research on probabilistic judgments has attracted much attention by accounting researchers (e.g., Libby, 1975a; 1975b; Casey, 1980a; 1983; Zimmer, 1980; 1981; Tomassini, Solomon, Romney and Krogstad, 1982; Solomon, Ariyo and Tomassini, 1985; Casey and Selling, 1986; Keasey and Watson, 1986; Moeckel and Plumlee, 1989; Dilla, File, Solomon and Tomassini, 1991; Ismail and Simnett, 1991; Pincus, 1991; Selling, 1993; Mladenovic and Simnett, 1994; Simnett, 1994). One important task for the future research in this area specifically highlighted by Wright, Rowe, Bolger and Gammack (1994, p.7) is to identify the important factors that contribute to the optimal performance of probabilistic judgments. This task is also the focus of the current study.

One common approach to measuring the performance of probabilistic judgments in behavioural science is to evaluate the appropriateness of a judge's confidence in a prediction task (Lichtenstein and Fischhoff, 1977; Lichtenstein, Fischhoff and Phillips, 1982; Sniezek, 1990; Yates, 1990; Griffin and Tversky, 1992; Bolger and Wright, 1993; Wright *et al.*, 1994). Confidence is a judge's estimation of the probability that his/her judgment is correct. For instance, the task of a subject is to choose A or B as the correct alternative and then he/she is asked to state a probability between 50% and 100% that the selected option is in fact correct: 50% indicating no confidence and 100% indicating full confidence. Alternatively, confidence can be expressed as a value between 0% and 100% which is a judge's probabilistic prediction for a chance event such as a firm in financial distress. Also, confidence can be identified by the width of a confidence interval. Appropriateness of confidence is how well a judge's confidence matches either the normative probability of correct judgments or the proportion of his/her actual correct judgments (Griffin and Tversky, 1992). The normative probability can be derived from a normative statistical model, such as the Bayesian rule, on the basis of a single observation by incorporating base-rate information, while the actual proportion of a judge's correct judgments needs to be determined over a large number of assessments.

Due to the limited number of observations available in a research experiment and the need to understand more about the effect of base-rate information on human's probabilistic judgments, and in order to make statistical inference on the basis of these findings, an important line of research on probabilistic judgments in psychology focuses on the use of the Bayesian rule to investigate the appropriateness of a judge's confidence (Dunning, Griffin, Milojkovic and Ross, 1990; Vallone, Griffin, Lin and Ross, 1990; Griffin and Tversky, 1992). According to this normative statistical model, if a judge's confidence is equal to the corresponding normative probability, his/her confidence is considered to be appropriate. A judge is overconfident if his/her

confidence is greater than the corresponding normative probability, whereas a judge is underconfident if his/her confidence is less than the corresponding normative probability.

For instance, if a bank loan officer estimates the probability of a firm being in financial distress is 80%, then his/her confidence of the prediction of financial distress can also be taken as 80%. If the normative probability of the firm being in financial distress is also 80%, then the bank loan officer is said to have appropriate confidence. However, if the normative probability is only 70%, then the bank loan officer is considered to be overconfident. Or if the normative probability is 90%, then the bank loan officer is seen as underconfident. Therefore, inappropriate confidence includes both overconfidence and underconfidence. This approach to measuring the performance of probabilistic judgments in terms of degree of underconfidence or overconfidence is recognised as a finer measure than the traditional accuracy measure which only indicates the proportion of a judge's correct answers in a judgment task.

The importance of studying appropriateness of confidence cannot be underestimated. Appropriateness of confidence is conceived as a persistent trait or characteristic for particular types of experts performing particular judgment tasks. Inappropriate confidence of a substantial nature may carry with it undesirable consequences of which many judges themselves are not even aware. One such consequence is to entice people to commit judgment errors leading to poor decisions (Fischhoff and MacGregor, 1982; Neale and Bazerman, 1985; Heath and Tversky, 1991; Griffin and Tversky, 1992; Selling, 1993).

Previous research focused solely on the adverse effects of overconfidence. However, both overconfidence and underconfidence of bank loan officers when predicting the probabilities of firms being in financial distress can have adverse effects. Bank loan officers with overconfidence when predicting future financial distress of loan

applicants may tend to reject loan applications even if submitted by good clients. Bank loan officers may be so confident as not to recognise that insufficient or inappropriate information might have been used to reject those loan applications. Even if bank loan officers are not so confident as to reject the loan applications immediately, they may not be willing to concede during the negotiations with their potential clients. The consequence is to reduce the chance of making successful deals.

Similarly, bank loan officers with a high overconfidence tendency when predicting future financial distress of clients who have already been granted the loans may attempt to exercise undue caution by monitoring healthy firms. This over-monitoring may cause much inconvenience to the healthy clients, leading to possible deterioration in relationships between the two parties. Moreover, this undue level of monitoring may cause distress among those bank loan officers with high overconfidence because of the frequent confrontations with their clients.

Underconfidence when predicting firms' future financial distress also may lead to undesirable consequences. Bank loan officers with high underconfidence will tend to grant loans to applicants who are considered as having low probabilities of financial distress, when in fact the actual probabilities are high. The underconfidence tendency may entice bank loan officers to grant loans to financially unsound applicants without recognising the risk associated with their decisions. As a result, they may fail to take subsequent measures to offset this risk. These measures may include the imposition of security or guarantee requirements as a condition for granting the loans, or the diversification of the loan portfolios of their banks. Significant underconfidence when predicting financial distress may also lead to insufficient monitoring of problem clients who were granted loans. The consequences of underconfidence may therefore have serious adverse effects on the career prospects of bank loan officers, as well as the financial stability of their banks and the banking system as a whole.

Therefore, it can be seen that the measure of appropriateness of confidence goes beyond the traditional accuracy measure by providing insights into one's tendency to commit errors in future decisions. This tendency is represented by the degree of overconfidence or underconfidence. However, most previous studies on appropriateness of confidence were undertaken in psychology, and there has been relatively little judgment and decision research in accounting focusing on this important judgment performance variable, particularly related to the task of bank loan officers predicting firms being in financial distress. The wide variety of support for the overconfidence phenomenon in the psychology literature therefore presents an interesting and important research topic for accounting researchers. Indeed, more specific judgment and decision research in accounting has been called for in this area (Tomassini *et al.*, 1982; Solomon *et al.*, 1985; Casey and Selling, 1986; Moeckel and Plumlee, 1989; Dilla *et al.*, 1991; Ismail and Simnett, 1991; Pincus, 1991; Selling, 1993; Mladenovic and Simnett, 1994; Simnett, 1994).

1.2 Research Problems and Objectives

To avoid the various adverse consequences arising from inappropriate confidence as mentioned earlier, it is important to determine empirically whether bank loan officers tend to have inappropriate confidence. If they do, then it is also important to identify the major factors that could affect the degree of their inappropriate confidence. Researchers in psychology also express a similar need for more research to identify the major factors contributing to optimal performance in general probabilistic judgments (Wright *et al.*, 1994, p.7). This advocacy is attributed to the limited theories and empirical evidence available in both psychology and accounting for understanding those factors. The current study attempts to fill this research gap by providing answers for the following two research problems:

(1) Do bank loan officers tend to have appropriate confidence when predicting the probabilities of firms being in financial distress?

(2) What are the effects of some selected major factors on the appropriateness of bank loan officers' confidence when predicting the probabilities of firms being in financial distress?

The primary objective of the current study is to provide empirical evidence on the degree of bank loan officers' inappropriate confidence as well as the effects of some selected influencing factors when predicting the probabilities of firms being in financial distress. This objective is justified by the unique task nature of these predictions and the serious consequences of inappropriate confidence of bank loan officers as discussed earlier. The justification for the current study will be further discussed in Section 1.3.

The secondary objective of the current study is to fill the said research gap and to integrate the research efforts on appropriateness of confidence in both psychology and accounting. The integration of these research efforts is carried out by examining the robustness of some behavioural decision theories on appropriateness of confidence as developed in psychology when applied to accounting studies on financial distress predictions. Therefore, the current study attempts to generalise some theories on general probabilistic judgments from psychology into an accounting context, and the findings from these accounting studies can provide further insights back into the original theories. The current study also attempts to extend some behavioural decision theories on probabilistic judgments as developed in psychology beyond their original scope. Therefore, the current study not only contributes to its

immediate research discipline of behavioural decision research in accounting, but also adds new knowledge to its parent research discipline of behavioural decision theory in psychology.

1.3 Justification for the Study

The significance of the current study can be justified by the important role played by bank loan officers in the banking industry. According to the statistics provided by the Hong Kong Government, there were 168 licensed banks with 1,433 branches in Hong Kong by the end of December 1993. The total amount of loans and advances to customers was 2,713,505 million Hong Kong dollars, which accounted for 47.5% of the total assets of all these banks (Census and Statistics Department, Hong Kong, 1994). Bank loan officers are charged with the responsibility to look after such a large portion of asset portfolios in their banks and therefore their judgments on how to grant and administer these assets will have significant impacts on the financial health of the whole banking industry.

The recent failure of the Bank of Credit and Commerce International (BCCI) in Hong Kong challenged the adequacy of protection for depositors in Hong Kong, and reopened the debate on the necessity of imposing a deposit insurance scheme in Hong Kong. The public's attention has also been directed to the issue of the adequacy and effectiveness of controls imposed by the Government for safeguarding the stability of the banking system in Hong Kong. This concern has led to the demand for more financial disclosures from Hong Kong's licensed banks, especially for information on their reserves. All these recent developments support the notion that more attention is now being paid by the public to the operation of the banking system in Hong Kong.

Although bank loan officers play an important role in the banking industry, there is a lack of research focusing on examining the appropriateness of their confidence when predicting the probabilities of firms being in financial distress. Only two studies were found in the U.S. examining the appropriateness of confidence for financial distress predictions by using students as surrogates for bank loan officers (Casey and Selling, 1986; Selling, 1993). A few other studies (e.g., Tomassini *et al.*, 1982; Solomon *et al.*, 1985; Keasey and Watson, 1986; Moeckel and Plumlee, 1989; Dilla, *et al.*, 1991; Ismail and Simnett, 1991; Pincus, 1991; Mladenovic and Simnett, 1994; Simnett, 1994) did use real subjects such as auditors to investigate the appropriateness of their audit judgment confidence. Therefore, more research on the performance of bank loan officers is justified in view of the significant impact of their inappropriate confidence as discussed in Section 1.1. More studies are especially called for to determine the major factors affecting the appropriateness of bank loan officers' confidence.

On the practical side, the findings of the current study can be useful to both users and providers of financial statement information. Bank loan officers are major users of financial statement information. In view of the serious adverse effects of inappropriate confidence on bank loan officers, their understanding of the nature of inappropriate confidence will help them have more insights into their judgments. The findings of the current study would allow them to understand some major influencing factors to which they should pay particular attention in order to minimise inappropriate confidence. This information can also be useful for bank management to reallocate its resources more effectively by improving bank loan officers' job performance.

Providers of financial information and information systems designers can also benefit from understanding these major factors that could affect the extent of inappropriate confidence among bank loan officers. The possibility and the degree of inappropriate

confidence could be reduced if more relevant information and more appropriate warning signals could be incorporated in the information systems which are designed for assisting bank loan officers in making judgments.

Finally, the findings of the current study would be important for those trainers who are charged with responsibility to design and conduct training programmes for bank loan officers. To attain more appropriate confidence is a teachable and learnable skill (Russo and Schoemaker, 1992). By understanding the major factors that could affect the appropriateness of bank loan officers' confidence, a training programme can then be designed to cope with their needs and to reduce the possibility and the degree of inappropriate confidence in their judgments.

1.4 Research Model and Hypotheses

1.4.1 Research Model

Three specific potential factors have been identified from the psychology research literature and are considered to have a significant impact on the appropriateness of bank loan officers' confidence in financial distress predictions. These three factors are the relevance of base-rate information, the need for cognition (NC) trait of bank loan officers, and the perceived informativeness of case-specific evidence (i.e., the financial ratios of a firm). The first two factors were viewed as the primary independent variables of interest, while the last factor was of an exploratory and supplementary nature. The effects of all these factors on appropriateness of confidence have not been investigated by any previous studies in either psychology or accounting.

Although task predictability (or a similar concept called task difficulty in Lichtenstein *et al.*, 1982) would also have an impact on the appropriateness of bank loan officers' confidence (e.g., Casey and Selling, 1986; Selling, 1993), it was not examined in the current study because this factor does not relate directly to base-rate information which was the focus of the current study. Nonetheless, for comparison purposes, findings of additional analyses will be presented in Chapter VI for the effects of the primary factors examined in the current study on the appropriateness of bank loan officers' confidence after controlling for the effect of task predictability.

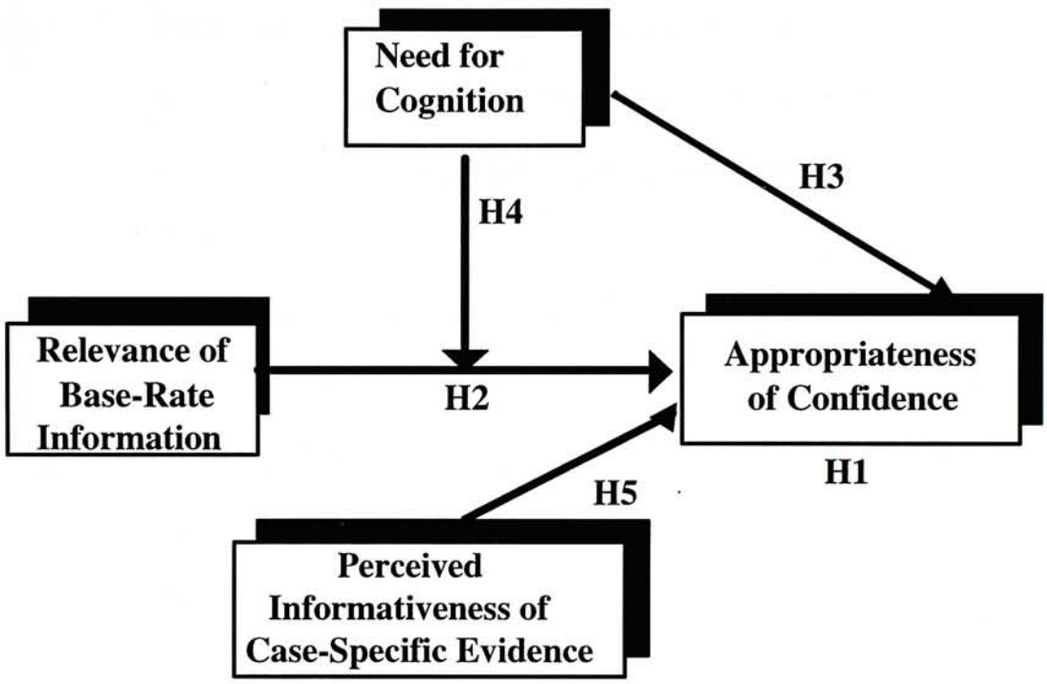
The research model is depicted in Figure 1.1 which shows the hypothesised direct effects of the relevance of base-rate information, the NC trait of bank loan officers, and the perceived informativeness of case-specific evidence on the appropriateness of bank loan officers' confidence (H2, H3 and H5 respectively). It also indicates the hypothesised moderating effects of the NC trait of bank loan officers on the relationships between the relevance of base-rate information and the appropriateness of bank loan officers' confidence (H4). The development of this research model will be explained in more detail in Chapter IV.

1.4.2 Research Hypotheses

Five research hypotheses were developed from the research model. The underlying logic of each of these hypotheses will be explained in full in Chapter IV, after the relevant literature is reviewed in Chapters II and III. These research hypotheses are listed below:

H1: Bank loan officers tend to have overconfidence when predicting the probabilities of firms being in financial distress.

Figure 1.1 Research Model



H2: Bank loan officers who are given the more relevant base-rate information tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do those who are given the less relevant base-rate information.

H3: High NC bank loan officers tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers.

H4: High NC bank loan officers tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers when they are given the less relevant base-rate information. Conversely, high NC bank loan officers do not tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers when they are given the more relevant base-rate information.

H5: Bank loan officers who perceive case-specific evidence as being more informative tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do those who perceive case-specific evidence as being less informative.

The testing of Hypothesis 1 can provide an answer to the first research problem. Specifically, the purpose of testing Hypothesis 1 is to investigate whether bank loan officers really do have inappropriate confidence when predicting the probabilities of firms being in financial distress. The testing of Hypotheses 2 to 5 can provide answers to the second research problem, that is, to determine to what extent the three specific potential factors identified could significantly affect the appropriateness of bank loan officers' confidence.

1.5 Research Methodology

In order to enhance the reliability and validity of the findings, the current study adopted a causal type of research methodology by conducting a field experiment and using real bank loan officers as subjects. Data was gathered by individual interviews

with bank loan officers. A total of 50 bank loan officers from the Bank of China Group (a banking network consisting of 14 different independent banks) participated in the current study.

As the relevance of base-rate information was the only independent variable or treatment that could be manipulated by the investigator in the experiment, the subjects were divided into two base-rate information groups. The subjects in the experimental group received the more relevant base-rate information, while the subjects in the control group received the less relevant base-rate information.

The experiment instrument was assembled in a booklet and distributed to each subject during the interview. Each instrument contained ten different corporate financial profiles and the subsequent additional base-rate information to aid the subjects in predicting the probability of each firm being in financial distress, along with a sub-instrument measuring the NC trait of each bank loan officer. Each subject's perceived informativeness of case-specific evidence (see the definition in the next section) was also classified into one of the two groups: the more informative and the less informative.

The two-group design adopted by the current study measures observations before and after the treatment (i.e., the type of base-rate information) by dividing the experiment into two consecutive prediction tasks. In Task 1, each subject in the two base-rate information groups was asked to make a "financial distress likelihood" estimation for each of the ten given corporate financial profiles without being given base-rate information. In Task 2, the subject was given back the "financial distress likelihood" estimations he/she had made in Task 1, together with additional base-rate information (either the more relevant or the less relevant type). The subject was then asked again to make a "financial distress probability" estimation for each of the ten given corporate financial profiles. Appropriateness of confidence could then be

calculated for each prediction made by a subject by comparing his/her "financial distress probability" estimation with the normative probability calculated by using the Bayesian rule.

To test the five research hypotheses, the data collected was then analysed by mainly using a t-test and an unbalanced ANOVA test. Supplementary tests by using different unbalanced ANOVA models and repeated measures ANOVA, and by controlling for the effect of task predictability, were also conducted to provide additional insights into the findings. The full details of the measurements of the variables, the experimental design, the data collection method and the statistical analysis methods used in the current study will be discussed in Chapter V.

1.6 Definitions of Key Terms

Definitions of a term adopted by different researchers are often not uniform. Therefore, several key terms used in the current study are first defined here to avoid potential semantic problems in the remaining parts of the study.

Confidence is a judge's estimation of the probability that his/her judgment is correct. *Appropriateness of confidence* is how well a judge's confidence matches the normative probability of correct judgments (Griffin and Tversky, 1992). This normative probability can be derived from a normative statistical model, such as the Bayesian rule, on the basis of a single observation. According to this model, if a judge's confidence is equal to the corresponding normative probability, his/her confidence is considered to be appropriate. A judge is *overconfident* if his/her confidence is greater than the corresponding normative probability, whereas a judge is *underconfident* if his/her confidence is less than the corresponding normative probability.

A base rate is the relative frequency of the targeted events in the corresponding populations (e.g., the percentage of financially distressed firms in the population). *The base-rate fallacy* is an individual's tendency to under-utilise base-rate information in favour of case-specific evidence, rather than integrate the two as prescribed in the normative probability theories. *The relevance of base-rate information* is defined as the degree to which the base-rate information is relevant to a particular judgmental task. *The more (less) relevant base-rate information* is the base-rate information which is more (less) relevant to a particular judgmental task.

Case-specific evidence is the basic financial ratio information with which a judge can predict how likely it is a firm will be in financial distress. *The perceived informativeness of case-specific evidence* is defined as how informative the case-specific evidence is perceived by a judge as being helpful in predicting the probability that a firm will or will not be in financial distress. *The more informative case-specific evidence* enables one to judge that the specific firm is either very likely (say > 70%) or very unlikely (say < 30%) to be in financial distress. Conversely, *the less informative case-specific evidence* does not help one judge that the specific firm is either very likely or very unlikely (say between 30% and 70%) to be in financial distress.

Financial distress likelihood is an assessment of how likely it is that a firm will be in financial distress in the coming year, estimated by a bank loan officer using only the financial ratio information contained in the firm's corporate financial profile. *Financial distress probability* is the probability that a firm will be in financial distress in the coming year, estimated by a bank loan officer using both the financial ratio information contained in the firm's corporate financial profile and additional base-rate information. Financial distress likelihood and financial distress probability are basically the same type of measurement and the use of different names aims to

distinguish the two prediction tasks conducted in sequential order during the experiment.

Need for cognition (NC) refers to a general personality trait that relates to the tendency of an individual to engage in and enjoy expending cognitive effort to do a task (Cacioppo and Petty, 1982; Cacioppo, Petty and Kao, 1984; Verplanken, Hazenberg and Palenéwen, 1992). A *high NC* individual refers to an individual who has a high tendency to engage in and enjoy expending cognitive effort. Conversely, a *low NC* individual refers to an individual who has a low tendency to engage in and enjoy expending cognitive effort.

In addition, the terms *judgment*, *prediction*, *estimation* and *assessment* will be used interchangeably throughout the study, although theoretically there may be slight differences among them (Libby, 1981). The operationalisation and measurement of the above variables will be further discussed in Section 5.7 of Chapter V.

1.7 Scope of the Study

The current study will draw upon theories and frameworks from several disciplines, including accounting, finance and banking, psychology, behavioural decision-making, and statistical modelling. One major strength of the current study is the integration of work which has, until recently, been separated. It should also be noted that the scope of the current study is restricted to individual judgments; group and organisational judgments are not investigated.

1.8 Organisation of the Thesis

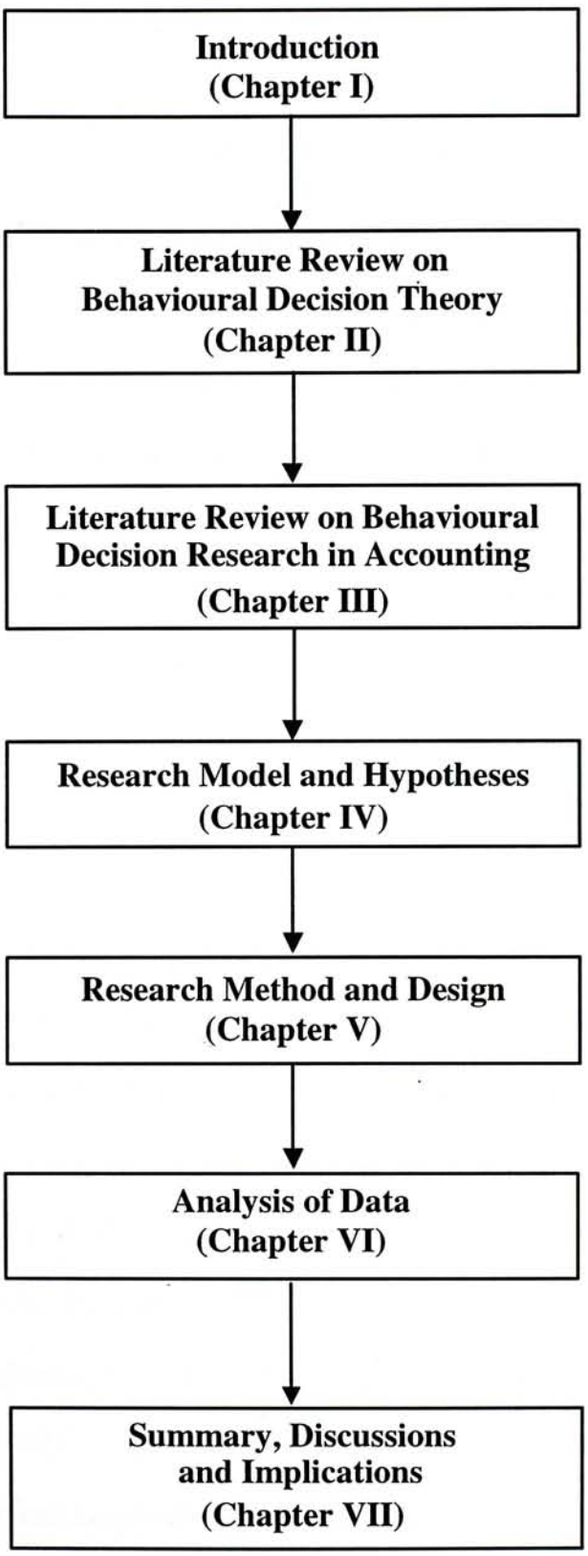
This thesis is organised around seven chapters (see Figure 1.2). After the overview of the current study given in this chapter, Chapter II provides a detailed literature review on behavioural decision theory as developed by psychology researchers. This research area is considered to be the parent discipline of the current study. Chapter III then reviews the literature on behavioural decision research in accounting. This latter research area is considered to be the immediate discipline of the current study.

Chapter IV develops the research model of the current study which depicts the hypothesised effects of the relevance of base-rate information, the NC trait of bank loan officers, and the perceived informativeness of case-specific evidence on the appropriateness of bank loan officers' confidence. Five research hypotheses are constructed and their underlying logic are discussed.

Chapter V discusses the methodology adopted for the current study, including the experimental design, sample selection, instrument design, data collection, and data analysis methods. Chapter VI analyses the data collected from the field experiments and the results on testing each of the five research hypotheses are presented.

Finally, Chapter VII provides the conclusions for the findings of the current study. The implications for theories and practice from these findings are discussed. The chapter also specifies the potential limitations of the current study and suggests some directions of further research in this area.

Figure 1.2 Organisation of the Thesis



CHAPTER II

LITERATURE REVIEW ON BEHAVIOURAL DECISION THEORY

2.1 Introduction

This chapter and the next provide a detailed review of the literature pertinent to the current study. This chapter first presents a literature review on Behavioural Decision Theory (BDT), which is considered to be the parent research discipline of the current study. The next chapter will then review the literature of Behavioural Decision Research (BDR) in accounting, which is considered to be the immediate research discipline of the current study. Together they provide both background and context for the current study. Such an extensive review of the relevant literature is also considered important for developing and refining the research model and hypotheses of the current study.

The remainder of this chapter is organised around seven sections. Section 2.2 first provides an overall picture of BDT in a chronological perspective since the 1950's. Four major areas of findings or ideas in BDT research during this period are then highlighted. Section 2.3 discusses the Principle of Bounded Rationality, the first major area of findings in BDT research that laid the foundation for the past four decades of BDT research. Sections 2.4 to 2.6 then review the literature of the other three major areas of findings, with each area of these findings forming its own research framework in BDT. These frameworks include the Lens Model, Heuristics-and-Biases, and Contingent Decision Behaviour frameworks. Section 2.7 attempts to provide an integrated framework linking these four major areas. Finally, Section 2.8 gives a summary of the chapter. Instead of providing a comprehensive review of BDT, the focus of this chapter is on reviewing the major findings that have high potential for applying to accounting research.

2.2 Behavioural Decision Theory: Historical Development

BDT is concerned with the study of how individuals make decisions[1] (Slovic, Fischhoff and Lichtenstein, 1977; Hogarth, 1993). The research on studying human decision-making has long been an important topic, but much of the research conducted today can be traced back to several far-reaching classical publications in the 1950's (Hogarth, 1993).

Edwards (1954) reviewed and brought together the research on decision behaviour carried out by economists, statisticians, and philosophers. In defining the domain of BDT, he argued that psychology researchers could use normative decision models drawn from economics and statistics to investigate whether people's judgments were consistent with these models. At about the same time, Simon (1955) introduced the Principle of Bounded Rationality by a landmark research paper on investigating the limited information processing capacity of human beings. This principle, in effect, defines the problems that the researchers of BDT have been trying to solve ever since. In addition, Meehl (1954) compared human judgments with statistical predictions, and illustrated the limitations of both human judgments and statistical predictions in terms of judgment and prediction accuracy (see Section 2.4 on the discussion of the limitations of human judgments and statistical predictions). Hammond (1955) extended human judgments research by applying the Brunswik's lens model to compare the correlation of a set of cues with a decision criterion and with human judgments on the same criterion (also see Section 2.4).

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[1] *Judgment* usually refers to the process of estimating outcomes and their consequences, while *decision-making* involves an evaluation of these consequences, which leads to a choice among the alternatives. Judgment provides inputs for decisions. These two terms, however, are used interchangeably in this thesis (Libby, 1981). In addition, *prediction* usually refers to the judgment for future events. Similarly, the terms *prediction* and *judgment* are also used interchangeably in this thesis.

An increasing amount of empirical work and further development of the above ideas was found in the 1960's, due mainly to the use of computers in research. Of particular importance is the development of the Bayesian approach to statistical decision theory (Raiffa and Schlaifer, 1961), highlighting the normative statistical standards for measuring the performance of people's probabilistic judgments.

Substantial progress in the field was found in the 1970's. Tversky and Kahneman (Tversky and Kahneman, 1971; 1973; 1974; Kahneman and Tversky, 1972) laid the foundation of the "Heuristics-and-Biases" approach to developing BDT. They described the general human cognition process at an intermediate stage, and suggested that people use simplified "rules of thumb", called heuristics, to make decisions. The use of these heuristics sometimes works well in people's ordinary life and saves much of their cognitive effort. The extensive use of these heuristics, however, leads to less economically rational behaviour.

BDT has been in a period of consolidation and extension since the 1980's. On the one hand, researchers sought to extend, challenge, and refine the insights of human decision behaviour developed in the preceding decades. On the other hand, the previous findings were applied to different fields, such as negotiation (e.g., Neale and Bazerman, 1985; 1991). Some topics that did not receive much attention previously were explored, such as ambiguity of probabilities (e.g., Einhorn and Hogarth, 1985), the order effects of belief updating (e.g., Hogarth and Einhorn, 1992), and contingent decision behaviour (e.g., Payne, 1976; 1982; Johnson and Payne, 1985; Bettman, Johnson and Payne, 1990; Simon, 1990; Payne, Bettman and Johnson, 1988; 1990a; 1993).

The above overview on the major achievements in BDT research over the past four decades can be summarised into four major areas of findings or ideas[2]. These areas include one principle and three research frameworks. The Principle of Bounded Rationality (Section 2.3) laid the foundation of the research conducted under the three frameworks. These frameworks include the Lens Model (Section 2.4), Heuristics-and-Biases (Section 2.5) and Contingent Decision Behaviour (Section 2.6). Each of these research frameworks represents a distinguished approach to examine the various issues in BDT research. Although the current study did not make use of all these areas of findings, a review of each of these areas would help the author develop and refine the specific research model and hypotheses in the current study. These areas of findings are discussed in more detail in the next four sections.

2.3 Bounded Rationality

Traditional economic theory postulates a human being as an economic man, who is expected to act rationally in making decisions. This man is assumed to have knowledge of the relevant aspects of his environment, to have a well-organised and stable system of preferences, and to have ability in computation that enables him to calculate and select the best among the available alternative courses of action. This best course of action allows him to reach the highest attendable preference as prescribed by the theory of Subjective Expected Utility.

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[2]Hogarth (1993) suggested eight major findings or ideas of BDT research in the recent decades. These findings or ideas are: (1) that judgment can be modelled; (2) bounded rationality; (3) to understand decision-making, understanding the task is more important than understanding the people; (4) levels of aspiration/reference points; (5) use of heuristic rules; (6) the importance of adding; (7) search for confirmation; and (8) thought as construction. The literature review of BDT research in this chapter reclassifies these findings or ideas into one principle and three research frameworks. This principle or each of these frameworks represents the research interests for a distinguished group of researchers who are in pursuit of similar approaches and methodologies to develop BDT. Therefore, this new classification can provide more insights into the development of this field.

These assumptions of an economic man under traditional economic theory, however, have been challenged by researchers of BDT. First, traditional economic theory does not consider the limitations of the human organism. In particular, the short-term memory and the computational capacity of human beings are very limited (Simon, 1955; Miller, 1956). Second, an economic man may not be able to specify the exact nature of the outcomes in view of unanticipated consequences. Third, the traditional economic model stipulates that all alternatives are evaluated before a choice is made (Simon, 1955). Finally, the classical theory of perfect rationality does not recognise the multiple goals in decision-making and leaves no room for regrets, second thoughts, or weakness of will (Simon, Dantzig, Hogarth, Plott, Raiffa, Schelling, Shepsle, Thaler, Tversky and Winter, 1987).

In view of the handicap in using traditional economic theory to predict the rational human decision behaviour, Simon (1955) proposed an insightful Principle of Bounded Rationality[3] to describe actual human decision behaviour. Simon argued, in actual human decision-making, that only a subset of alternatives is available and these alternatives are often examined sequentially. The first satisfactory alternative that meets the minimum requirement as defined by an individual's aspiration level will be selected. This aspiration level may change in the sequence of trials. As the individual, in his exploration of alternatives, finds it easy to discover satisfactory alternatives, his aspiration level rises; as he finds it difficult to discover satisfactory alternatives, his aspiration level falls.

Adjusting the aspiration level is not the only way to raise the chance of reaching a satisfactory solution; adjusting the size of the subset of alternatives can also be used

[3] Bounded Rationality was named by Simon (1990) as a principle, although it was also called a concept by other researchers (e.g., Simon, 1955; Hogarth, 1993). To conserve the founder's latest ideas, this thesis adopts Simon's latest discussion of this area and names it as a principle (Simon, 1990, p.6). However, it is not the intention of the author of this thesis to argue whether Bounded Rationality is a principle or a concept. For this reason, the terms 'principle' and 'concept' are taken to be the same in this thesis.

to serve a similar purpose. If satisfactory alternatives can be identified easily, the subset of alternatives will be narrowed; if it becomes difficult to find satisfactory alternatives, the subset of alternatives will be broadened. The characteristics of decision makers will determine which adjustment will be used. The more persistent the decision makers, the greater the role played by adjusting the subset of alternatives, relative to the role played by adjusting the aspiration level (Simon, 1955).

Although the assumptions underlying human decision behaviour in economics and psychology are contradictory to each other, both of these two disciplines describe human decision behaviour as rational. Their interpretations of rationality, however, are different. Simon (1986) used substantive and procedural rationality to account for this difference. Economics researchers recognise that a substantively rational person always reaches the best decision objectively in terms of the given utility function. Psychology researchers consider that a procedurally rational person makes a decision in a procedurally reasonable way in the light of the available knowledge and means of computation.

The Principle of Bounded Rationality has had a far-reaching effect on BDT research of the past four decades. On the one hand, the different research frameworks in BDT fit in very well with this principle. On the other, this principle defines the problems of suboptimal human decision behaviour for other researchers in this field to explain. The next three sections will discuss these three research frameworks in detail according to the chronological order of their development.

2.4 Lens Model

The Lens Model is one of the earliest judgment models used by psychology researchers in undertaking cognitive psychology research (Hammond, 1955). The Lens Model developed by Brunswik (1952; 1955; 1956) suggests that the outcomes of a criterion variable can be explained by a set of interrelated environmental cues. Decision makers also use those cues to predict the outcomes of the same criterion variable. This framework argues that simple linear models, with the environmental cues as independent variables, work remarkably effectively at making predictions about the outcomes of the criterion variable as well as the human decision behaviour (Meehl, 1954; Goldberg, 1970; Dawes, Faust and Meehl, 1989; Kleinmuntz, 1990).

In developing the linear models for predicting human decision behaviour, it was found that the effectiveness of the models depended largely on identifying the right environmental cues and including all those cues in the models. Deviations from optimal weighting for those cues in the models did not usually make much practical difference for the accuracy of the models (Dawes and Corrigan, 1974).

In general, the predictions based on the linear models of judges were found to be better than the intuitive judgments made by the same judges (Goldberg, 1970; Dawes *et al.*, 1989). The rationale is simply that the predictions obtained from the models are more consistent than the human judgments. Therefore, the linear models of judges set the upper limit of the intuitive judgments of the judges themselves (Hogarth, 1975).

In some situations, however, human judgments may have the potential to outperform the linear models of the same judges. When the judges have additional insights in which the models had not incorporated, and when judges have picked up a rare cue that would never have been anticipated by the models, the judges can outperform the models. In these cases, the number of cues used by a judge is greater than the number of cues already included in the relevant models. Furthermore, when the models are inflexible and become less accurate due to changes in environment, human judgments become more realistic (Blattberg and Hoch, 1990; Yaniv and Hogarth, 1993).

In view of both human judgments and the linear models of judges having strengths and weaknesses, combining human judgments with models, therefore, has a high potential to improve judgment performance[4]. This suggestion was supported by several studies such as Blattberg and Hoch (1990) and Yaniv and Hogarth (1993). As just mentioned, models are consistent in their predictions, but they are inflexible in dealing with unexpected events and environmental changes. Judges are able to use information redundant to the environment to get insights into a judgment case. However, judges are found to be suboptimal in making judgments, due to their limited information processing capacity. Judges are also found to be too adaptive and over-reactive to the current events. Therefore, a model-man combination can increase adaptivity while placing a regressive, but necessary, upper bound on that adaptivity. In this case, model and man are complementary to each other and may stabilise the judgment performance.

[4] The terms *judgment performance* and *judgment quality* are used interchangeably in this thesis. Judgment performance includes, among others, judgment accuracy and appropriateness of confidence as discussed in this thesis.

2.5 Heuristics and Biases

2.5.1 Overview

The Lens Model framework argued that simple linear models, with the environmental cues as independent variables, work very well at predicting the outcomes of the criterion variable. At the same time, the model predictions can be used to compare with the performance of human judgments. In contrast, the Heuristics-and-Biases framework was established by Tversky and Kahneman in the 1970's and adopted Edwards' (1954) view on using normative models as standards for comparing the performance of human judgments. The focus of this framework was on the errors and mistakes of people when they made judgments. The suboptimal judgment performance among people as stipulated in this framework could be explained by the limited capacity in human information processing as proposed in the Principle of Bounded Rationality (Simon, 1955). Therefore, the Heuristics-and-Biases framework fits in very well with this principle.

The discussion of the Heuristics-and-Biases framework in this section is divided into two parts. The first part deals with the three heuristics that are most commonly used among people, including the availability, anchoring and adjustment, and representative heuristics (Sections 2.5.2 to 2.5.4). Heuristics are the basic rules of thumb used in an intermediate stage of human cognition processes. People's use of heuristics, in most cases, works fairly well in daily life, but these heuristics may sometimes lead people to commit judgmental biases.

The second part of this review then focuses on the judgmental biases. These biases include the conjunction fallacy, hindsight bias, order effects of belief updating, sunk cost effect, framing effect, confirmation bias, accountability, base-rate fallacy, and

overconfidence effect (Sections 2.5.5 to 2.5.13). These biases are not only of interest from the viewpoint of psychology, but have also been used by many other disciplines for explaining human decision behaviour in practice, including decision behaviour in accounting.

2.5.2 Availability Heuristic

Availability refers to a heuristic adopted by a person when he/she evaluates the frequency of classes or the probability of events by how easily the relevant instances or associations can be brought to mind (Tversky and Kahneman, 1973). The use of the availability heuristic may lead to systematic biases when the actual frequency of the events is unknown or difficult to retreat from the memory. Two classical psychology studies that examined this heuristic are described below.

In an experiment to illustrate this heuristic, Tversky and Kahneman (1973) asked 152 subjects to judge whether the given five letters appeared more often in the first or in the third position of given words. They found that 105 subjects judged the first position to be more likely for a majority of those letters, and 47 judged the third position to be more likely for a majority of those letters. In fact, all five letters were more frequent in the third position than the first position. It was also found that provision of a financial incentive for better performance did not reduce this bias among the subjects. The results of this experiment can be explained in terms of the availability heuristic. It is certainly easier to think of words that start with a specific letter than of words where the same letter is in the third position.

Similarly, Lichtenstein, Slovic, Fischhoff, Layman and Combs (1978), in studying how people judged the frequency of death from various causes, found that their subjects tended to overestimate small frequencies and underestimate larger ones. The

subjects were also found to have exaggerated the frequencies of some specific causes and underestimated the frequencies of others. They traced these biases to the disproportionate exposure, memorability, or imaginability of various events. The results of this experiment further support the notion that availability is affected by various subtle factors unrelated to actual frequency, such as familiarity, recency, and emotional saliency. Therefore reliance on the availability heuristic to make judgments may result in systematic biases.

2.5.3 Anchoring and Adjustment Heuristic

The anchoring and adjustment heuristic is a general judgment process by which people use an initially generated or a given response as an anchor and arrive at the final answer by adjusting away from this anchor. Such adjustments, however, are often found to be inadequate, as the final judgments are too close to the anchor (Tversky and Kahneman, 1974). A classical study in psychology which examined this heuristic is discussed in detail below to illuminate the ideas behind the above definition.

In an experiment to investigate this heuristic, Tversky and Kahneman (1974) asked their subjects to estimate the percentage of African countries in the United Nations. Before the estimation exercise, a number between 0 and 100 was determined by spinning a wheel of fortune in the subjects' presence. The subjects were instructed to indicate first whether the given number was higher or lower than the actual percentage, and then to estimate the actual percentage by moving upward or downward from that number.

In this experiment, the numbers generated by spinning a wheel of fortune were used by the subjects as anchors. As suggested by the anchoring and adjustment heuristic, the amount of adjustments indicated by the subjects were found to be inadequate. The median estimates of the percentage were found to be 25 and 45 for groups that received ten and 65 respectively as starting points. It was also found that provision of incentives for accuracy did not reduce this anchoring and adjustment effect.

In another experiment, Tversky and Kahneman (1974) asked two groups of high school students to estimate, within five seconds, a numerical expression written on the blackboard. One group was presented a numerical expression of "8 x 7 x 6 x 5 x 4 x 3 x 2 x 1", while the other group was presented the same numerical expression in the reversed order of "1 x 2 x 3 x 4 x 5 x 6 x 7 x 8". Since the time available was not sufficient for performing a complete calculation, the subjects could only perform a few steps of calculations by using the first few numbers. The results of these calculations were then used as anchors and the final estimates could be made by extrapolations or adjustments. It was found that the median estimate for the ascending sequence was 512, while the median estimate for the descending sequence was 2250. The median estimates of these two groups differed substantially and were far removed from the correct answer of 40,320.

Besides explaining how an anchoring and adjustment process can lead to systematic biases in human judgments, the result of this experiment also suggests that the presentation order could be an important consideration for subjects to select their anchors. This heuristic provides the basis on which the theory of the order effects in belief updating is developed. This theory will be discussed later in more detail (see Section 2.5.7).

2.5.4 Representativeness Heuristic

Representativeness is a heuristic to evaluate the probability of an uncertain event, or a sample, by judging the degree to which the event is similar in essential properties to its parent population, or the degree to which it reflects the salient features of the process by which it is generated (Kahneman and Tversky, 1972; 1973).

This definition can further be elaborated by a classical study in psychology. In an experiment to investigate this heuristic, Kahneman and Tversky (1972) found that most of their subjects erroneously believed that families of six children in which the exact order of birth of a girl (G) and a boy (B) was BGBBBB were less frequent than families in which the exact birth order was GBGBBG. In fact, the given two birth sequences are about equally likely. However, most people will surely agree that they are not equally representative. The sequence of BGBBBB appears less random and thus less representative.

The biases resulted from using the representativeness heuristic are not limited to naive subjects. Sophisticated psychologists were also found to use this heuristic in viewing even small samples as highly representative of the populations from which they were drawn. This belief led them to underestimate the error and unreliability inherent in small samples of data (Kahneman and Tversky, 1972).

The three heuristics most widely used among people have been discussed in this part of the review. These heuristics can be used to explain some human judgmental biases found in the research on human decision behaviour. These judgmental biases are discussed in detail in Sections 2.5.5 to 2.5.13.

2.5.5 Conjunction Fallacy

The simplest and most fundamental law of probability is the extension rule. This rule stipulates that if the extension of A includes the extension of B (i.e., A⊃B), then P(A) >= P(B). In this case, the set of possibilities associated with a conjunction of A&B is included in the set of possibilities associated with A. The same principle can also be expressed by the conjunction rule P(A&B) <= P(A). Specifically, a conjunction cannot be more probable than any one of its constituents. This rule is valid regardless of whether A and B are independent, and is valid for any probability assignment on the same sample space. The violation of the conjunction rule in a direct comparison of A to A&B is called the conjunction fallacy (Tversky and Kahneman, 1983).

The commitment of the conjunction fallacy can be explained by both the representativeness and availability heuristics (see Sections 2.5.2 and 2.5.4 for the details of these two heuristics). People's conception of the probability of events is based on natural assessments that are routinely carried out as part of the perception of events and the comprehension of messages. Such natural assessments include computations of similarity and representativeness, attributions of causality, and evaluations of the availability of associations and exemplars. When the conjunction is perceived as being more representative or can more easily be brought to mind than its constituents, people become more likely to commit the conjunction fallacy.

This fallacy was demonstrated by an experiment conducted by Tversky and Kahneman (1973). In investigating how the use of the availability heuristic might lead to the conjunction fallacy, two versions of a question on estimating word frequency were given to their subjects. In the first version of the question, the subjects were asked to estimate how many seven-letter words ended with "ing" in four pages of a novel (about 2,000 words). The second version of the question requested them to estimate how many words occurred in the form of "-----n-" in the

same reading material. It is certainly easier to recall words ending in "ing" than words with only the letter "n" in the second to last position. Words ending in "ing", however, are in the subset of words with the letter "n" in the second to last position. The results of this experiment indicated that the subjects were not aware of this obvious probabilistic relationship. The median estimates for the frequency of words were 13.4 for the first version of the question, and 4.7 for the second version of the question.

The conjunction fallacy can be mitigated by several manipulations to induce extensional reasoning. First, people are more likely to pay attention to extensional reasoning if they are required to assess the relative frequency of both classes before assessing the relative frequency of their intersection. Second, an explicit reference to the number of individual cases encourages the subjects to set up a representation of the problems in which class inclusion is readily perceived and appreciated.

In general, the conjunction fallacy is a rather robust phenomenon across different contexts including estimation of word frequency, personality judgment, medical prognosis, decision under risk, suspicion of criminal acts, and political forecasting. Systematic violations of the conjunction rule are observed in the judgments of lay people and experts in both between-subjects and within-subject comparisons. It was reported that statistically sophisticated subjects conformed more to the conjunction rule in a transparent test, although the incidence of violations was fairly high even in this group of intelligent and sophisticated respondents (Tversky and Kahneman, 1983).

In summary, the extent of the conjunction fallacy is determined by the nature of the evidence, the formulation of the question, the transparency of the event structure, the appeal of the use of heuristics, and the sophistication of the respondents. Whether

people obey the conjunction rule in a particular situation depends on the balance of all these factors.

2.5.6 Hindsight Bias

The hindsight bias is the tendency for individuals with outcome knowledge (hindsight) to claim that they would have estimated a probability of occurrence for a reported outcome that is higher than they would have estimated without the outcome information (Fischhoff, 1975; Slovic and Fischhoff, 1977; Connolly and Bukszar, 1990; Hawkins and Hastie, 1990; Creyer and Ross, 1993). The hindsight bias, therefore, is a projection of new knowledge into the past accompanied by a denial that the outcome information has influenced the judgment. One major consequence of the hindsight bias is overconfidence because the accuracy of prior expectation is exaggerated.

The hindsight bias is believed to result from general memory processes. Some researchers (e.g., Fischhoff, 1977; Fischhoff and Beyth, 1975) suggested that the answer to a question or the outcome of an event is immediately integrated into one's pre-existing knowledge. Subsequently, information about one's prior state of knowledge is lost. Therefore, the use of outcome knowledge to estimate the probabilities of past events is an unconscious process.

The hindsight bias can be reduced by increasing cognitive effort (Arkes, Faust, Guilmette and Hart, 1988; Creyer and Ross, 1993). For instance, Creyer and Ross found that the hindsight bias, under certain conditions, could be mitigated when subjects worked hard. The specific conditions identified were that the attractiveness of a partially described option was uncertain, an attribute with missing information

was the most important one, or the importance of an attribute with missing information was ambiguous.

Generating reasons for outcomes in hindsight and reviewing one's foresight perspective could also be used as ways to reduce this bias (Davies, 1987; Arkes *et al.*, 1988; Creyer and Ross, 1993). However, the results of the previous studies that examined the effectiveness of focusing on foresight manipulations for reducing the hindsight bias were mixed. For instance, contrary to the findings of other studies (Davies, 1987; Arkes *et al.*, 1988; Creyer and Ross, 1993), Fischhoff (1977) found that simply warning subjects about the phenomenon or asking them to work harder to accurately recall their foresight state of knowledge did not reduce the hindsight bias.

2.5.7 Order Effects in Belief Updating

Belief updating has long been an interesting topic for psychology researchers. This topic is particularly relevant to probabilistic inference (Edwards, 1968; Slovic and Lichtenstein, 1971; Hogarth, 1975; Schum, 1980; Fischhoff and Beyth-Marom, 1983). Individual studies have long been existed, but a meta descriptive theory on the order effects in belief updating was developed by Hogarth and Einhorn (1992) only recently.

Suppose that there are two pieces of evidence, say A and B. Some subjects express an opinion after seeing the information in the order A-B (i.e., first evidence A, then evidence B); others receive the information in the order B-A. An order effect occurs when opinions after A-B differ from those after B-A.

The theory proposed by Hogarth and Einhorn assumes that people handle belief-updating tasks by a general, sequential anchoring-and-adjustment process in which

the current opinion serves as an anchor and is adjusted by the impact of succeeding pieces of evidence. These adjustments depend on the relative positions between the impact of succeeding pieces of evidence and the reference points. The reference points adopted, in turn, are determined by the tasks.

Based on these assumptions as described above, Hogarth and Einhorn proposed a basic belief-adjustment model as:

$$S_k = S_{k-1} + w_k [s(x_k) - R], \qquad (2.1)$$

where:

S_k = the degree of belief in some hypothesis, impression or attitude after evaluating k pieces of evidence ($0 <= S_k <= 1$).

S_{k-1} = an anchor or prior opinion. The initial belief is denoted S_0.

$s(x_k)$ = the subjective evaluation of the kth piece of evidence.

R = the reference point or background against which the impact of the kth piece of evidence is evaluated.

w_k = the adjustment weight for the kth piece of evidence ($0 <= w_k <= 1$).

This theory suggests that the order effect of revising belief depends largely on task characteristics. The key task variables identified are evidence encoding, the length of an evidence series, response mode (Step-by-Step or End-of-Sequence), and the complexity of evidence items. The effects of these task variables on the basic belief adjustment model as depicted in Equation (2.1) are discussed below under three subprocesses: evidence encoding, response mode, and adjustment weighting.

2.5.7.1 Evidence Encoding

The means by which people encode evidence depends on whether the tasks are evaluation or estimation. In evaluation tasks, people encode evidence as positive or

negative relative to the hypothesis under consideration, such that $-1 <= s(x_k) <= +1$ and $R = 0$. By substituting $R = 0$ into Equation (2.1), the belief-adjustment model for evaluation tasks takes the form:

$$S_k = S_{k-1} + w_k\, s(x_k). \qquad (2.2)$$

In contrast, estimation tasks involve assessing some kind of "moving average" (e.g. impression of "likableness") that reflects the position of each new piece of evidence relative to the current opinion. In other words, in estimation tasks people are sensitive to the difference between the location of the current anchor (i.e. S_{k-1}) and the level of opinion suggested by the evidence. As an estimate or measure of opinion, evidence is seen as unipolar such that $0 <= s(x_k) <= 1$ and $R = S_{k-1}$. By substituting $R = S_{k-1}$ into Equation (2.1), the belief-adjustment model for estimation tasks takes the form:

$$S_k = (1 - w_k)\, S_{k-1} + w_k\, s(x_k). \qquad (2.3)$$

2.5.7.2 Response Mode

There are two response modes (or processes): Step-by-Step (SbS) and End-of-Sequence (EoS). Specifically, when using a SbS process, a person is assumed to adjust his or her opinion incrementally by each piece of evidence processed. This assumption exactly matches the assumption adopted in Equation (2.1). With an EoS process, however, the initial anchor is assumed to be adjusted by the aggregate impact of the succeeding set of evidence. The belief-adjustment model for an EoS process takes the form:

$$S_k = S_0 + w_k\, [s(x_1, \ldots, x_k) - R], \qquad (2.4)$$

where $s(x_1, \ldots, x_k)$ is a range of some functions, possibly weighted averages, of the individual subjective evaluations (or scale values) of evidence items that follow the anchor.

Hogarth and Einhorn suggested that people try to match a cognitive strategy with a response mode but shift the strategy if the response mode is too demanding on their cognitive effort. Therefore, they suggested that when the response mode is SbS, a SbS process is always used. When the response mode is EoS, however, the process used depends on the length of an evidence series and the complexity of evidence items. An EoS process is expected more likely to be used for a short series of cognitively simple evidence items, and a SbS process is more likely adopted for cognitively complex evidence items or a longer evidence series in order to cope with the information-processing demands of the task.

2.5.7.3 Adjustment Weighting

This last subprocess is related to the effects of the value of an anchor on revising belief upon the impact of new evidence items. Hogarth and Einhorn proposed a "contrast effect" that when a piece of negative evidence is received, belief will be affected more by a large anchor than by a small one. Similarly, when a piece of positive evidence is received, belief will be affected more by a small anchor than by a large one.

The rationale behind this effect is that when the current belief (an anchor) is already low, a piece of negative evidence cannot reduce the anchor greatly in terms of absolute adjustments. When the current belief is strong, however, the same negative evidence has higher potential to adjust the anchor downward in absolute terms. A similar argument is applied to a situation where a piece of positive evidence is received. Thus, the adjustment weight for the kth evidence item can be stated as:

$$w_k = \alpha\, S_{k-1}, \text{ when } s(x_k) <= R; \qquad (2.5a)$$

$$w_k = \beta\, (1 - S_{k-1}), \text{ when } s(x_k) > R; \qquad (2.5b)$$

where α and β are constants.

By substituting Equations (2.5a) and (2.5b) into Equation (2.1), the belief-adjustment models for a SbS process can be written as:

$$S_k = S_{k-1} + \alpha S_{k-1} [s(x_k) - R] \qquad \text{for } s(x_k) <= R; \qquad (2.6a)$$

$$S_k = S_{k-1} + \beta (1 - S_{k-1}) [s(x_k) - R] \qquad \text{for } s(x_k) > R. \qquad (2.6b)$$

2.5.7.4 Order Effects

In summary, the order effects in belief updating for SbS and EoS processes depend on evidence coding, response mode, the length of an evidence series and the complexity of evidence items. Under estimation tasks ($R = S_{k-1}$), a SbS process always predicts recency (for α, β not equal to 0). Under evaluation tasks ($R = 0$), a SbS process predicts no order effects for consistent evidence but always predicts recency in the sequential evaluation of mixed evidence except if α or β is 0.

For an EoS process, a force towards primacy holds no matter whether the evidence is all positive, all negative, or mixed. Hogarth and Einhorn also discussed in detail the effect of task characteristics, such as the complexity of evidence items and the length of an evidence series. While some discussion has been provided in this section, further details of these topics, though interesting, are beyond the scope of this literature review and are therefore not pursued.

Hogarth and Einhorn also conducted five experiments to verify the accuracy of their proposed belief-adjustment models. The results of Experiments 1 to 4 supported the models' predictions of no order effects for consistent evidence and recency effects for mixed evidence. These results also held across both the SbS and the EoS response modes. Moreover, the contrast effect was supported. In Experiment 5, they

attempted to rule out the potential alternative explanations for the results in Experiments 1 and 2 by testing the order effects for consistent evidence in both evaluation and estimation tasks. As predicted, consistent evidence led to recency in estimation tasks but no order effect was found in evaluation tasks.

2.5.8 Framing Effect

The framing effect describes the phenomenon of people's choices being affected by changes in how a situation is described or framed. This effect violates the principle of description invariance which states that the way a situation is described should not affect one's decision. The framing effect is defined in two different senses: the strict definition of the framing effect refers to pairs of problems that involve a redescription of an exactly identical situation; the loose definition refers to pairs of problems that are not exactly the same, but are equivalent from the perspective of economic theory. These two definitions of the framing effect were illustrated in the two experiments conducted by Tversky and Kahneman (1981) and are discussed below.

In investigating the strict definition of the framing effect, Tversky and Kahneman (1981) gave their subjects a case that the U.S. was preparing for an outbreak of an unusual Asian disease which was expected to kill 600 people. Subjects were asked to make a choice between two rescue programmes. The consequences of these two programmes, however, were described under two different frames. In the first framing, the consequences were that if Programme A was adopted, 200 people would be saved. If Programme B was adopted, there was a one-third probability that 600 people would be saved and a two-thirds probability that no people would be saved. In the second framing, the consequences were that if Programme A was adopted, 400 people would die. If Programme B was adopted, there was a one-third probability that nobody would die and a two-thirds probability that 600 people would die.

The two framings were actually the redescriptions of an identical situation. The only difference between the two framings was that the consequences of the first framing were described as how many people would be saved, whereas the consequences of the second framing were described as how many people would die. The results, however, indicated that the majority of people chose Programme A in the first framing, and Programme B in the second framing. This experiment clearly demonstrates that people's choices vary as a result of the way a situation is described, or framed.

Tversky and Kahneman (1981) also examined the loose definition of the framing effect. They asked their subjects to make a choice between two situations in a problem. In the first situation, subjects were supposed to have paid $10 for a ticket to see a play. When the subjects got to the theatre, they discovered that they had lost their ticket. The seat was not marked and the ticket could not be recovered. Subjects were asked whether they would buy a new ticket in this situation. In the second situation, subjects were assumed to go to see a play that cost $10 per ticket. When the subjects got to the theatre, they discovered that they had lost a $10 bill. The subjects were asked whether they would then buy a ticket in this situation.

The results revealed that more subjects were willing to buy a ticket in the second situation than in the first situation. Unlike the problem that was used to investigate the strict definition of the framing effect, these two situations were not redescriptions of exactly the same situation. In one situation the subjects had lost a ticket that cost $10 and in the other situation they had actually lost $10. However, the two situations were equivalent in that, in both cases, the subjects' total wealth had decreased by $10. Thus, from a purely monetary perspective, the difference in the two situations was irrelevant.

Two possible reasons have been proposed to account for why people treat equivalent situations differently. The first explanation is that the framing effect is similar to perceptual illusions. That is, although the choice that a person makes is affected by framing, the option that the person would actually experience as more desirable is not. The second explanation is that framing affects decisions because it affects the option that the person would actually experience as being more desirable (Frisch, 1993).

Frisch supported the notion that most people who showed the framing effect did not agree the equivalence of the two versions even when they directly compared the two versions. This finding supports the second explanation of a genuine belief among people that changing the "frame" significantly alters the situation; it is therefore reasonable for them to make different choices in different frames.

2.5.9 Sunk Cost Effect

In basic management accounting, finance or economics courses, students are reminded that economic decisions should only be influenced by incremental or opportunity costs. Costs expensed in the past cannot be rectified and should therefore be irrelevant to these decisions. However, this expected rational economic behaviour is often violated, which leads to a robust judgment bias called the sunk cost effect. The sunk cost effect is a tendency of irrational economic behaviour to continue an endeavour once an investment in money, effort, or time has been made (Arkes and Blumer, 1985; Simonson and Staw, 1992).

In an experiment to investigate this bias, Arkes and Blumer (1985) asked their subjects to consider a situation where they had spent $100 on a ticket for a weekend ski trip to Michigan. Several weeks later the subjects bought a $50 ticket for another

weekend ski trip to Wisconsin, and they were assumed to enjoy the Wisconsin ski trip more than the Michigan one. As the subjects were putting their just-purchased Wisconsin ski trip ticket in their wallet, they noticed that the Michigan ski trip and the Wisconsin ski trip were for the same weekend. It was too late to sell either ticket, and they could not return either one. The subjects had to use one ticket and not the other. They were then asked on which ski trip they would go. Contrary to an axiom of traditional economic theory that decisions should be based on the costs and benefits that are expected to arise at the choice of each option, it was found that 54% of the subjects in Arkes and Blumer's experiment chose the Michigan trip. Obviously the larger sunk cost of the Michigan trip had influenced many subjects' choices.

The sunk cost effect can be explained as the psychological justification for the desire not to waste prior money. The admission that one has wasted money would seem to be an aversive event. Staw (1976) showed that when business students felt responsible for a financially unsuccessful prior decision, they continued to invest more money into that option than if their prior decision was successful. In this example, negative consequences fostered further commitment to the chosen course of action.

Prospect theory (Kahneman and Tversky, 1979) can provide a theoretical framework to explain the effect of sunk cost (Arkes and Blumer, 1985; Garland and Newport, 1991). Under this theory, an investor considers an equal amount of gain or loss to have an equal amount of perceived value, when an initial investment is being considered. After a substantial unsuccessful investment has been made, the investor is at a point where further losses do not result in large decreases in the perceived value; however, comparable gains do result in large increases in the perceived value. Therefore, the investor at this point will risk only small perceived losses to obtain possible large perceived gains. This point represents a situation where the investor has paid a sunk cost. Compared to the position where a person considers the initial

investment, the person at this point is more likely to make a risky investment, that is, to continue adding funds to the sunk cost.

Simonson and Staw (1992) suggested that three procedures could be used to mitigate the sunk cost effect. The first procedure is to make negative outcomes less threatening. The second procedure is to set minimum target levels that, if not achieved, would lead to a change in policy. The third procedure is to evaluate decision makers on the basis of their decision process rather than the outcome. Simonson and Staw also found that there was only moderate support for the contention that personal involvement increased the sunk cost effect. Moreover, the sunk cost effect was not lessened by having taken prior courses in economics in which the sunk cost effect was specifically discussed.

The final issue relating to the sunk cost effect is the question of whether absolute or relative sunk costs are more important in the decision to continue investing in a course of action. Garland and Newport (1991) conducted a series of experiments to investigate this issue. They found that the sunk cost effect was a function of the proportion of allotted resources, such as a budget, expended on a project rather than the absolute expenditures.

2.5.10 Confirmation Bias

The confirmation bias refers to the tendency to seek information that is relevant only to confirm the hypothesis under consideration (Wason, 1960; Skov and Sherman, 1986; Higgins and Bargh, 1987; Klayman and Ha, 1989). An example to illustrate this bias was cited by Wason (1960), which examined the hypothesis testing strategies adopted by people in a rule discovery experiment. Subjects were told that the three numbers 2, 4, 6 conformed to a simple relational rule that the experimenter

had in mind, and they were asked to discover the rule by generating sequences of three numbers. Then the experimenter would tell them each time whether the rule held for their sequence. The subjects were also asked to state the rule only when they were highly confident that they had discovered it.

The results indicated that the subjects did not attempt to eliminate their hypotheses in this task. In addition, provision of financial incentive was found only to have the effect of significantly increasing the number of series generated before making an announcement of their guess. It had no effect on the tendency to discover the correct rules. Therefore, the failure to eliminate hypotheses was not due to a lack of motivation. These results also suggested that even intelligent adults did not readily adopt a scientific attitude to a novel problem. They adhered to their own explanations with remarkable tenacity when they could produce confirming evidence for them.

In another experiment, Wason and Johnson-Laird (1972) investigated the confirmation bias in deductive reasoning by giving their subjects four cards with "E", "K", "4", and "7" facing up. Subjects were told that each of the cards had a letter on the one side and a number on the other. They were then provided with the rule that if a card had a vowel on the one side, then it had an even number on the other. Subjects were asked to name only those cards needed to be turned over to determine whether the rule was true or false. Wason and Johnson-Laird found that the vast majority of the subjects said either "E and 4", or "only E". Both answers, however, are wrong; the correct answer is "E and 7". This given rule is actually a simple conditional logic statement: if p then q. The subjects in this experiment were, however, found to commit a similar confirmation bias, without due regard to the correct course of action to select not-q.

The usual explanation for the confirmation bias is that people prefer conceptually positive information: that is for thinking about the presence rather than the absence of properties (Nisbett and Ross, 1980; Higgins and Bargh, 1987). Another explanation is that in many real situations, such as choosing an employee, a job, a spouse, or a car, people must similarly live with their mistakes. Thus, they may be naturally inclined to focus more on verifying their favourable hypotheses in mind in those situations (Klayman and Ha, 1987).

The confirmation bias can also be explained as a result of using the Heuristics-and-Biases approach in information gathering. In particular, people may use the representativeness heuristic to start with a hypothesis that contains one or two of the most salient features of the known target case in inductive reasoning tasks. They may then add, delete, and replace such features as the feedback suggests (Klayman and Ha, 1989). The confirmation bias may be caused by the hindsight bias in which people falsely believe they knew the outcome would occur, and thus they convert negative feedback to positive feedback (Skov and Sherman, 1986).

Moreover, the confirmation bias can be explained by the loss aversion effect as proposed in prospect theory (Kahneman and Tversky, 1979). People seek confirmation instead of disconfirmation because they value the possible psychological loss such as embarrassment, disappointment or regret (Davidsson and Wahlund, 1992). Davidsson and Wahlund further contended that the failure of people to search for and use negative information in the previous studies that examined this bias was due to their tasks not being concrete enough for their subjects to recognise the correct solutions. Also, inadequate activation of the decision rule or memory cueing induced by the task structure was proposed as another reason to account for this bias. For these reasons, they tested three additional tasks along with the four-cards task adopted from the experiment conducted by Wason and Johnson-Laird. These three tasks were considered as being more concrete and related more to real-life cases.

Davidsson and Wahlund found that both of these factors significantly affected the degree of the confirmation bias. Therefore, these findings have lent additional comfort to the effects of the confirmation bias on real-life situations.

2.5.11 Accountability

Accountability refers to the need to justify one's views and preferences to others (Tetlock, 1983a, Simonson and Nye, 1992). Accountability may have a substantial impact on decision makers. Accountable decision makers are more likely than unaccountable ones to use cognitively complex rules in choosing among response options (Tetlock, 1983a), to be more aware of the determinants of their judgments (Hagafors and Brehmer, 1983), to display greater consistency and stability of their judgments (Hagafors and Brehmer, 1983), to process persuasive messages in detail rather than to rely on their general evaluation of the message's source (Chaiken, 1980), and to be more discriminating and responsive to evidence in evaluating others (Tetlock, 1983a; 1985a).

Previous studies on the effects of accountability supported the notion that accountability leads decision makers to devote more effort to their judgments, which can be used to reduce the judgmental biases originating from a situation where they have not expended much cognitive effort on the judgmental tasks. It was found that accountability reduced the primacy effects in impression formation by increasing willingness to pay attention to all the evidence and to modify initial impressions in response to contradictory evidence (Tetlock, 1983b).

Accountability also reduced people's tendency to over-emphasise particular attributes in an essay-attribution context by increasing sensitivity to the situational pressures on others (Tetlock, 1985b). Furthermore, accountability reduced the overconfidence

effect in a personality-prediction context by increasing awareness of complexities in the behaviour of others (Tetlock and Kim, 1987). Finally, accountability reduced the sunk cost effect in a personal finance context by directing the attention of subjects to the irrelevance of sunk costs (Simonson and Nye, 1992).

Accountability, however, is recognised as being more effective in preventing than in reversing judgmental biases. Once subjects have assimilated or integrated information into their impressions of a person or event, they have difficulty in reinterpreting that information. It was argued that accountability had a marked impact on the initial impression-formation process, but that it had little impact after the initial processing had occurred (Tetlock and Kim, 1987).

In addition, accountability did not reduce a variety of decision errors for which the correct response was not known and unlikely to be identified with more thorough information processing. Simonson and Nye (1992) found that accountability did not promote consistent preferences across different preference elicitation procedures, did not direct the subjects' attention to the small sample effect and the framing effect, and did not mitigate the base-rate fallacy and the conjunction fallacy.

Accountability can have negative effects on human decision behaviour and thus leads to judgmental biases. As mentioned earlier, accountability induces complex thinking among decision makers and motivates them to use a wide range of information in making judgments. As a result, accountability will dilute the impact of the truly diagnostic variables by encouraging decision makers to integrate information from multiple sources before making a judgment. This is called the dilution effect (Tetlock and Boettger, 1989). Accountability also has an adverse effect on commitment of resources to a failing policy. Fox and Staw (1979) suggested that decision makers were more likely to escalate their commitment when they were most vulnerable (such as low job security) and were accountable to a sceptical board of directors.

2.5.12 Base-Rate Fallacy

The question of how people make probabilistic judgments for uncertain events has been a major focus in BDT (Payne, Bettman and Johnson, 1992). Because of the unobservable nature of cognitive processes, the study of these probabilistic judgments makes heavy use of normative standards to provide a benchmark against which performance of decision makers is evaluated. One such useful normative standard to analyse human judgment performance in BDT literature is the Bayesian rule. Under this normative principle of statistical prediction, accurate probabilistic judgments require judges to consider two sources of information, including "base-rate information" and "case-specific evidence".

A base rate is the relative frequency of those targeted events in the corresponding population (e.g., the percentage of financially distressed firms in the population). *Case-specific evidence* is the information about a specific prediction case at hand (e.g., the corporate financial profile of a targeted firm). The Bayesian rule prescribes that both sources of information should be given equal weight when judges make probabilistic judgments. A consistent finding in psychology literature, however, supports the notion that people tend to give undue weight to case-specific evidence and under-utilise base-rate information (Kahneman and Tversky, 1973; Bar-Hillel, 1979; 1980a; 1980b; 1982; 1983; Tversky and Kahneman, 1982a; 1982b; Bar-Hillel, 1984; 1990). This phenomenon is called "the base-rate fallacy".

The base-rate fallacy is people's tendency to under-utilise base-rate information in favour of case-specific evidence, rather than integrate the two as prescribed in the normative probability theories (Bar-Hillel, 1980a). The main reason for this tendency is that people are simply not very good at dealing with probabilistic data due to their

lack of a good mental framework for working with this data (Nisbett, Crandall and Reed, 1976; Maital and Paolucci, 1990). Instead of using sophisticated information processing strategies, people were found to rely on rather simple intuitive heuristics in making probabilistic judgments.

Kahneman and Tversky (1973) pioneered to empirically investigate this fallacy and conducted experiments to examine how people use the representativeness heuristic (see Section 2.5.4 for the details of this heuristic) to integrate information from different sources in making probabilistic judgments. In one of these experiments, they assigned a group of subjects randomly to two groups: the low-engineer and the high-engineer groups. Subjects in the low- (high-) engineer group were told that five thumbnail descriptions were chosen at random from 100 descriptions of 30 (70) engineers and 70 (30) lawyers. Each subject was given the same five descriptions. For example, one of the descriptions was given as follows (Kahneman and Tversky, 1973, p. 54):

> "Jack is a 45-year-old man. He is married and has four children. He is generally conservative, careful, and ambitious. He shows no interest in political and social issues and spends most of his free time on his many hobbies which include home carpentry, sailing, and mathematical puzzles."

After being given each description, subjects were asked to estimate the probability that the description was one of the 30 engineers (lawyers) in the sample of 100 descriptions. The results showed that explicit manipulation of base-rate information had a minimal effect on the subjects' probability estimation. Subjects relied mainly on the thumbnail descriptions (i.e., case-specific evidence) which was vivid, salient, concrete and thus more representative (Nisbett *et al.*, 1976). In contrast, the given base-rate information, by its very nature, was perceived as remote, pallid, abstract and not affecting representativeness. Base-rate information is thus generally under-utilised in probabilistic judgments in practice.

2.5.12.1 Reduction of the Base-Rate Fallacy

The extent of the base-rate fallacy can be reduced in many ways. One such way is based on the concept underlying the anchoring and adjustment heuristic (Tversky and Kahneman, 1974). This heuristic suggests that when two or more items of information are integrated in arriving at a probabilistic judgment, the more relevant information item will serve as an anchor and will dominate the judgment. The less relevant information item either will be ignored or will produce a minor adjustment to the initial judgment (the anchor). The base-rate fallacy can therefore be reduced by increasing the relevance of base-rate information, or by decreasing the relevance of case-specific evidence. These two methods are further discussed below.

2.5.12.1.1 The Relevance of Base-Rate Information

Two major approaches to increasing the relevance of base-rate information are causality and specificity. The *causality* approach is to provide a judge with information perceived to have a causal relation to the criterion. In making predictions, people rely on information perceived to have a causal relation with the criterion while disregarding valid but non-causal information. This conjecture was supported in several psychology studies that examined the base-rate fallacy (Ajzen, 1977; Tversky and Kahneman, 1982a; 1982b; Bar-Hillel, 1980a; 1981; 1983).

For example, in one of the experiments conducted by Ajzen (1977), a group of subjects were first given the information about the base rate of success on the final examinations of a course. They were then asked to estimate how likely a given student had passed the examination. Half of the subjects were given causal base-rate

information: two years ago, about 75% of the students passed (failed) a final examination in the same course. The percentage of the students passed or failed the examination was perceived to have a causal relation with the difficulty of the examination. The rest of subjects were given non-causal base-rate information: an educational psychologist intentionally selected about 75% students who had passed (failed) the examination for research purpose. The results indicated a significant interaction between the base rate of success (25% versus 75%) and the causality type of the base-rate information provided (causal versus non-causal). Specifically, although the causal base rate had a stronger effect than the non-causal base rate, prediction of success was, in each case, significantly higher for the 75% base rate than it was for the 25% base rate.

The second approach to increasing the relevance of base-rate information is *specificity*, that is to relate the base-rate information more specifically to the outcomes (Carroll and Siegler, 1977; Bar-Hillel, 1980a; 1983). Specificity is achieved by providing information on a smaller sample (e.g., the financial distress rate for a particular industry) rather than the population (e.g., the financial distress rate for all types of firms), of which the targeted case is a member. It was found that the more specific information tends to dominate the less specific one.

For example, Bar-Hillel (1983) suggested that, for the purpose of predicting the life expectancy of a newly born German baby, the life expectancy in Germany was perceived to be more relevant than the worldwide life expectancy. Another example was given by Bar-Hillel (1980a) in one of her experiments on the modified cab problem (p. 226):

> "Two cab companies operate in a given city, the Blue and the Green (according to the color of cab they run). Eighty-five percent of the cabs in the city are Blue, and the remaining 15% are Green. A cab was involved in a hit-and-run accident at night. The police

investigation discovered that in the neighborhood in which the accident occurred, which is nearer to the Green Cab company headquarters than to the Blue Cab company, 80% of all taxis are Green, and 20% are Blue."

Subjects were asked to think about the chances that the errant cab was green. The results revealed that major of the subjects gave an estimate of 80%, which was more consistent with the more specific base rate than the general base rate.

2.5.12.1.2 The Relevance of Case-Specific Evidence

As mentioned earlier, an increase in the relevance of base-rate information is not the only way to reduce the extent of the base-rate fallacy. This fallacy can also be mitigated by reducing the relevance of case-specific evidence. There are several situations where the relevance of case-specific evidence can be reduced. For example, when no or little case-specific evidence is provided, base-rate information is more likely to be used (Kahneman and Tversky, 1973; Lyon and Slovic, 1976; Bar-Hillel, 1980a; Tversky and Kahneman, 1982a). Likewise, when outcome categories are similar (e.g., the characteristics of financially distressed and financially non-distressed firms are similar), or when inconsistent or uninformative case-specific evidence (e.g., the corporate financial profile does not tell much about whether a firm will be in financial distress or not) is provided, base-rate information is more likely to be used (Ginossar and Trope, 1980). Finally, if subjects observe base rates being generated from a random sampling process, or if they have everyday experience with the problem, they are more likely to incorporate base-rate information in their judgments (Gigerenzer, Hell and Blank, 1988).

2.5.12.2 Effects of Need for Cognition on the Base-Rate Fallacy

The characteristics of judges have been identified as an important determinant of human judgment performance. Psychology researchers have found that there was a substantial variation in human judgment behaviour across different judges. Therefore, they advocated that future research should investigate the reasons for these differences (Juslin, 1994). One possible reason to account for this variation in human judgment behaviour across different judges can be attributed to a different degree of cognitive effort expended by the judges on the task. Cognitive effort has been recognised to have significant effects on the tendency to commit judgmental biases. Therefore, the extent of the base-rate fallacy committed by people in probabilistic judgments is expected to vary as a result of their cognitive effort expended.

The relationships of cognitive effort and the tendency to commit judgmental biases were also demonstrated in some research on accountability. As mentioned previously in Section 2.5.11, accountability induces people to devote more effort to their judgments. It was found that accountability reduced the primacy effects in impression formation by increasing people's willingness to pay more attention to all the evidence and to modify initial impressions in response to contradictory evidence (Tetlock, 1983b). Accountability also reduced people's tendency to over-emphasise particular attributes in an essay-attribution context by increasing sensitivity to the situational pressures on others (Tetlock, 1985b). Furthermore, accountability reduced the overconfidence effect (to be discussed in Section 2.5.13) in a personality-prediction context by increasing awareness of complexities in the behaviour of others (Tetlock and Kim, 1987). Finally, accountability reduced the sunk cost effect in a personal finance context by directing the subjects' attention to the irrelevance of sunk costs (Simonson and Nye, 1992). All these studies supported the notion that accountability, a social context variable, induces people to expend more cognitive

effort and leads people to be less likely to commit judgmental biases. The need for cognition trait of judges, an individual difference factor, can serve a similar purpose to distinguish those with a tendency to expend more cognitive effort from those with tendency to expend less cognitive effort.

Need for cognition (NC) refers to a general personality trait that relates to the tendency of an individual to engage in and enjoy expending cognitive effort to do a task (Cacioppo and Petty, 1982; Cacioppo *et al.*, 1984; Verplanken *et al.*, 1992). High NC individuals were found to be more active in information processing than low NC individuals. This difference in information processing could not be attributed to the differences in ability, but attributed to the differences in internal motivation to understanding their environment (Heppner, Reeder and Larson, 1983).

High NC individuals were found to be more effective in problem-solving (Heppner *et al.*, 1983), to expend more cognitive effort and to recall more message arguments (Cacioppo, Petty and Morris, 1983), to be more affected by argument quality but not the attractiveness of an endorser (Ahlering, 1987; Haugtvedt, Petty, Cacioppo and Steidley, 1988), and to process more information items (Verplanken *et al.*, 1992). All these findings support the notion that high NC individuals prefer complex to simple tasks, whereas low NC individuals prefer simple to complex tasks (Cacioppo and Petty, 1982).

NC can be used to explain some phenomena observed in the previous human information processing studies. For example, human beings are recognised as 'cognitive misers'. In performing most of the mental tasks, cognitive effort is a major factor determining the selection of an information processing strategy (Payne, 1982; Johnson and Payne, 1985; Payne *et al.*, 1988; 1990a; 1992). People tend to take short cuts in performing information processing tasks (Fiske and Taylor, 1984). NC is closely related to the degree of this cognitive miserliness. It is contended that the

NC trait of judges may moderate their extent of the base-rate fallacy in information processing (Ahlering and Parker, 1989, P.314).

As mentioned earlier, base-rate information is generally under-utilised in probabilistic judgments in practice, leading to systematic judgmental biases. Based on the Bayesian rule, the ratio of the probability of an event to the probability of a non-event is the product of the ratio of the base rate of an event to the base rate of a non-event and the ratio of the case-specific evidence of an event to the case-specific evidence of a non-event. When the base rate of an event is smaller than the base rate of a non-event, the under-utilisation of the base rate of the event could lead to an over-estimate of the probability of the event. This phenomenon is called the overconfidence effect and is the topic to be discussed in the next section.

2.5.13 Overconfidence Effect

People are frequently required to make probabilistic judgments under uncertainty. One approach to measuring the performance of these probabilistic judgments is to evaluate the appropriateness of people's confidence. As defined in Chapter I, confidence is the judge's belief that a stated judgment is correct, and is typically measured by evaluating the likelihood or probability that a prediction is correct. Appropriateness of confidence is how well the judges' confidence matches the actual probability. The actual probability can be derived from a normative statistical standard such as the Bayesian rule, or determined by the proportion of the judges' correct judgments over a large number of assessments (Griffin and Tversky, 1992). If the judges' confidence is equal to the actual probability, their confidence is considered as being appropriate. Judges are overconfident if their confidence is greater than the actual probability, whereas judges are underconfident if their confidence is less than the actual probability. A robust phenomenon supported by the

extant literature in psychology is that people tend to be overconfident in most probabilistic judgment tasks (Lichtenstein and Fischhoff, 1977; Fischhoff and Slovic, 1980; Fischhoff and MacGregor, 1982; Lichtenstein *et al.*, 1982; Sniezek, 1990; Yates, 1990; Griffin and Tversky, 1992).

For example, Lichtenstein and Fischhoff (1977) conducted a series of experiments to investigate whether people had appropriate confidence on some probabilistic judgment tasks. In the first experiment, a group of subjects were asked, for each of the given small drawings, to decide whether the drawer was a European child or an Asian child and to estimate the probability that their selection was correct. Similarly in the second experiment, another group of subjects were asked to indicate the direction of price movements for some stocks over a specific period. The results of both experiments were rather similar and showed that the subjects' percentage of correct predictions was significantly lower than their mean estimated confidence, thus leading to overconfidence.

Another example for demonstrating the overconfidence effect was a series of experiments conducted by Fischhoff and Slovic (1980) with a variety of different general discrimination tasks. Some of these tasks were similar to those used by Lichtenstein and Fischhoff (1977) and included handwriting recognition, diagnosing ulcers as malignant or benign on the basis of a smaller number of diagnostic signs, predicting stock price movements, picking the winner in horse racing, and sorting children's drawings according to their continent of origin (both with and without the instruction warning of impossible discrimination). The results of this series of experiments were quite consistent and supported the overconfidence effect.

Although the overconfidence effect has been recognised as a robust phenomenon supported by the extant literature, most of these studies asked student subjects to make probabilistic predictions on some general knowledge tasks. Whether the results

of overconfidence for these types of subjects and tasks were applicable to experts when they performed tasks of their expertise, was not addressed by them. These issues will be further discussed later in Section 2.5.13.4.

2.5.13.1 Calibration and Calibration Curve

The overconfidence effect was commonly demonstrated in previous studies by means of the appropriateness of judges' confidence (i.e., the extent of overconfidence or underconfidence), although it is not the only method available for measuring the quality of the judges' probabilistic judgments. Another commonly used measures of judgment quality are calibration and calibration curve. Calibration is the extent to which probability judgments correspond to the actual relative frequencies of events. People are said to be well calibrated if, over the long run, for all propositions assigned the same probability, the proportion of correct propositions is equal to the probability assigned (Lichtenstein and Fischhoff, 1977). For example, if an assessor assigns to a group of answers a probability of 70% as being correct and 70% of these answers turn out to be correct, then the assessor is said to be well calibrated (or perfectly calibrated). However, if only 50% or in fact 90% of these answers turn out to be correct, then the assessor is not well calibrated. Therefore, either over-estimation or under-estimation of the probability of correct judgments will lead an assessor to have poor calibration. Simply looking at the figure of calibration cannot tell whether the assessor over-estimates (overconfident) or under-estimates (underconfidence) his/her hit rate. Although calibration and overconfidence draw the same conclusion when an assessor has a perfect hit rate, calibration is more sensitive to the deviation from the perfect match between the confidence and the actual hit rate than overconfidence.

Calibration curve is a graph showing the hit rate (percentage correct) for each probability response assigned by an assessor. The horizontal axis of this graph usually represents the probability responses given by the assessor, while its vertical axis indicates the proportion of correct responses. Therefore, a curve along the diagonal of the graph suggests the assessor to be well calibrated. A curve below the diagonal shows that the assessor is overconfidence. In contrast, a curve above the diagonal reveals underconfidence. Although calibration curve provides readers with a visual pattern of the assessor's performance, this curve cannot tell whether the deviation from the perfect calibration (along the diagonal) is statistically significant. In view of the differences in strengths and weaknesses among the various measures mentioned above, overconfidence, calibration and calibration curve were usually used together in most of the studies in this line of research in order to provide more information on the assessor's judgment performance to the readers (Lichtenstein and Fischhoff, 1977; Fischhoff and Slovic, 1980; Fischhoff and MacGregor, 1982; Lichtenstein *et al.*, 1982; Sniezek, 1990; Yates, 1990; Griffin and Tversky, 1992).

Another common approach to measuring the performance of people's probability judgments is coherence. Both calibration and coherence have similar definitions, but they differ by using different actual probability estimates. Coherence refers to the extent to which probabilistic judgments correspond to a probability theory or model. Since people may use heuristic strategies to estimate their judgments and these judgments may deviate from the actual probability, calibration is therefore a measure of the judges' domain of knowledge or expertise for those specific judgment tasks, whereas coherence is a measure of the judges' probabilistic knowledge or their knowledge of the outcome frequencies pattern (Bolger and Wright, 1993; Wright *et al.*, 1994).

Although the extant literature supports the notion that overconfidence is a robust phenomenon, the understanding of the causes and consequences of this phenomenon

is still in its infancy. Theory development in this area requires the understanding of why overconfidence arises and how it can be reduced to improve judgment performance. Studies uncovering those factors affecting appropriateness of confidence are few in existence and more such studies are much needed (Sniezek and Buckley, 1993; Wright *et al.*, 1994). These factors can be classified into three major types (task, environment, and individual differences) and a brief review of each type of these factors is given in the next section.

2.5.13.2 Factors Affecting Appropriateness of Confidence

2.5.13.2.1 Task Factors

Task factors are considered to be the most important factors affecting appropriateness of confidence. These factors include the task difficulty (or a similar concept called predictability task), discriminability, who makes the choice, and whether decisions are made after judgments. The most consistent finding for the past two decades in this line of research is the effect of task difficulty on appropriateness of confidence. The extant research found that people tended to be overconfident when they made judgments on difficult tasks, but they were found to have more appropriate confidence and even to be underconfident when they made judgments on easy tasks (Lichtenstein and Fischhoff, 1977; Lichtenstein *et al.*, 1982; Sniezek, 1990; Yates, 1990; Griffin and Tversky, 1992). Tasks of high difficulty include those tasks which cannot be predicted solely by using the given information cues. Therefore, when people make judgments on tasks of high difficulty, they tend to be more overconfident than when they make judgments on tasks of low difficulty.

Discriminability refers to how similar the tentative alternatives are. When the alternatives are similar, their discriminability is low. Otherwise, when the alternatives are substantially different, their discriminability is high. It was found that when the discriminability between hypotheses was low, people tended to be overconfident. When the discriminability between hypotheses was high, however, people tended to be underconfident (Griffin and Tversky, 1992).

It has been argued that when people make a choice themselves rather than leaving the choice to someone else, they are more likely to remain committed to the selected choice. Research supported this notion and found that people tended to be more overconfident when they made the choice themselves rather than when someone else made the choice for them (Sniezek, Paese and Switzer III, 1990).

People usually need to make decisions based on the judgments made. The effects of the need to make decisions on appropriateness of confidence for the judgments were investigated by Paese and Sniezek (1991). They found that when people were made aware of the need to make decisions immediately after the judgments were made, the degree of overconfidence for the judgments was significantly reduced. This finding lends some comfort to the phenomenon of overconfidence, as people will usually make decisions based on their judgments.

2.5.13.2.2 Environmental Factors

Another important class of factors affecting appropriateness of confidence is the environment of a task. These factors include the amount of information available, the value of a base rate, introduction of an incentive, and provision of performance feedback. For example, people are recognised to have a limited information processing capacity. As more information is provided, people's attention to each

piece of information reduces. This phenomenon is called the dilution effect which induces people to use less relevant information in making judgments and thus leads them to have worse performance. This contention was supported by some previous studies which showed that as more information was provided, judges became more confident and overconfident (Oskamp, 1965; Peterson and Pitz, 1988).

A base rate plays an important role in belief revision. Previous studies strongly supported the notion that people tended to under-utilise base-rate information in revising their belief. This general tendency is called the base-rate fallacy which has been discussed in detail earlier in Section 2.5.12. It was also found that the base-rate fallacy had more pronounced effects on overconfidence when the base rate of an event was low than when it was high (Dunning *et al.*, 1990; Vallone *et al.*, 1990; Griffin and Tversky, 1992).

An incentive induces motivation and effort to perform better in judgments. Therefore, it is expected that provision of incentives will lead judges to have more appropriate confidence. In investigating the effect of incentives on appropriateness of confidence, Fischer (1982) found that subjects became less likely to assign very large or very small probabilities and had more appropriate confidence after the introduction of incentives.

Providing feedback will direct the judges' attention to understanding the logic behind judgments and outcomes. However, whether the judges' performance can be improved by providing feedback depends on whether the logic can be uncovered by the judges through more attention or effort. For this reason, it is expected that people will be more likely to perform better under the provision of feedback for easy tasks than they will for difficult tasks. This contention was supported by some previous studies (Lichtenstein and Fischhoff, 1980b; Arkes, Christensen, Lai and Blumer, 1987).

2.5.13.2.3 Individual Difference Factors

The third class of factors affecting appropriateness of confidence is individual difference factors. These factors include perceived expertise, need for cognitive structure, fear of invalidity, and perceived efforts expended. For example, Trafimow and Sniezek (1994) found that subjects who had higher perceived expertise had more appropriate confidence. In their study, Trafimow and Sniezek operationalised perceived expertise by asking their subjects to rank their class standing in high school and by advising the subjects of a high correlation between the class standing in high school and the performance of similar experiments conducted by other researchers.

Similarly, Wright *et al.* (1994) found that subjects with high self-rated expertise had less overconfidence than those with low self-rated expertise. The variable of self-rated expertise was measured by asking their subjects to rate how knowledgeable they perceived themselves to be about the issues tested in the experiment. Therefore, this self-rated expertise was a more direct measure of the subjects' perception of their knowledge about the task than the perceived expertise as used in Trafimow and Sniezek's experiment.

Mayseless and Kruglanski (1987) contended that the judges' motivation affected their knowledge acquisition process. To verify this contention, Mayseless and Kruglanski examined the effects of two motivational variables — need for cognitive structure and fear of invalidity — on appropriateness of confidence. Need for cognitive structure refers to the desire to possess knowledge on a given topic. People with high need for cognitive structure tend to promote an early closure on a solution to a judgmental problem. Thus, people with high need for cognitive structure are likely to inhibit the generation of competing alternatives to a given hypothesis when such

alternatives might appear to threaten an existing cognitive structure. The results of their study showed that subjects with lower need for cognitive structure had more appropriate confidence than those with higher need for cognitive structure.

Fear of invalidity is functionally opposite to need for cognitive structure. Fear of invalidity refers the desire to avoid judgmental mistakes. People with high fear of invalidity will devote more effort to their cognitive process in generating alternatives to a currently entertained hypothesis, and become more sensitive to information inconsistent with the hypothesis. Mayseless and Kruglanski (1987) found that subjects with high fear of invalidity had more appropriate confidence than those with low fear of invalidity.

The major reason that motivational factors, such as need for cognitive structure and fear of invalidity as examined by Mayseless and Kruglanski, affect appropriateness of confidence is that these factors induce people to expend more effort on making better judgments. Therefore, effort-related variables are also expected to affect appropriateness of confidence. One such variable is how much effort judges are perceived to have expended on a judgmental task. Paese and Sniezek (1991) measured subjects' perceived efforts by asking subjects to report the amount of personal effort expended on a task. They found that the subjects with higher reported perceived effort were more confident and overconfident than those with lower reported perceived effort.

2.5.13.3 Methods Promoting Appropriate Confidence

The second research issue related to appropriateness of confidence is how to reduce the degree of overconfidence in such a way to have more appropriate confidence. Many methods have been proposed by psychology researchers to mitigate the extent

of overconfidence. These methods include training with performance feedback, group discussion, provision of an incentive, promotion of considering alternatives, the need to making a decision after a judgment, understanding the task logic, and rating task difficulty to peer group. All these methods focus on manipulating the decision processes and environments, and are discussed in more detail below.

Training with performance feedback can be used to promote more appropriate confidence. The effectiveness of training, however, depends on how difficult the task is. As mentioned earlier in Section 2.5.13.2.1, people were found overconfident in making judgments for tasks of high difficulty, because they did not seem to make sufficient adjustments to their confidence according to the difficulty of these tasks (Lichtenstein and Fischhoff, 1977; Lichtenstein *et al.*, 1982; Sniezek, 1990; Yates, 1990; Griffin and Tversky, 1992). Also, provision of training for a difficult task does not help people much understand the mechanisms of the task. This argument was supported by some previous studies that provision of training with performance feedback could reduce the degree of overconfidence only for easy tasks but not for the difficult ones (Lichtenstein and Fischhoff, 1980b; Arkes *et al.*, 1987).

Group discussion of judges' answers is another possible way to promote more appropriate confidence. In an experiment conducted by Arkes *et al.* (1987), subjects who were told to explain their answers to the rest of their group were less overconfident than those who were not told to do so, even though those subjects who were told to explain their answers later were not actually requested to explain their answers in the end. The major reason to account for the results of this experiment was that when subjects anticipated having to justify their answers to a group of judges, their confidence levels dropped substantially, although their accuracy was similar to those who were not told to justify their answers to others.

Provision of incentives can motivate people to work hard and induce people to expend more cognitive effort. It is contended that people who are given incentives have better judgment performance. This contention was supported by a study showing that subjects who were given incentive pay for better performance were less overconfident (Fischer, 1982).

Another method to promote more appropriate confidence is by motivating subjects to consider more possible outcomes from a chosen alternative other than the outcome originally anticipated. One way to achieve the purpose of this method is to ask subjects to provide reasons why their original choice could be wrong. In investigating whether this method could be used as an effective debiasing tool to reduce overconfidence, Koriat, Lichtenstein and Fischhoff (1980) revealed that subjects who listed only contradicting reasons were found to be less overconfident. This method, however, received only modest support from other studies (Fischhoff and MacGregor, 1982; Trafimow and Sniezek, 1994). Hoch (1985) identified a specific condition under which this method could be effective. He found that for tasks with low to moderate base rates, judgment performance could be improved when subjects generated a reason against their judgments. For tasks with high base rates, however, generation of such a reason had no effect on judgment performance.

The need to make a decision after a judgment can also be used to promote more appropriate confidence in the judgment itself (Paese and Feuer, 1991). Therefore, people's judgment performance can be improved if they are instructed that a decision is required to be made after the judgment has been made. In practice, most people need to make decisions immediately after they make judgments. As such, the degree of overconfidence in real practice is expected to be much lower than that found in laboratory experiments (Juslin, 1994).

Keren (1992) suggested a structure-modifying technique to promote more appropriate confidence. Users of this technique are encouraged to understand the internal logic of a particular debiasing tool rather than following a procedure blindly. This is also a more effective way to learn a debiasing tool. Another method to promote more appropriate confidence is to let judges have a more objective view on how difficult the task is. This objective view of task difficulty can be obtained by asking the judges to rate how difficult the task is, not from their own viewpoint, but from the viewpoint of their peer group. This method proved effective in that subjects were found to be less overconfident when they were asked to rate task difficulty to fellow persons (Allwood and Montgomery, 1987).

2.5.13.4 Appropriateness of Experts' Confidence

As mentioned at the very beginning of Section 2.5.13, there is a robust phenomenon supported by the extant literature in psychology that people tend to be overconfident in most probabilistic judgment tasks (Lichtenstein and Fischhoff, 1977; Fischhoff and Slovic, 1980; Fischhoff and MacGregor, 1982; Lichtenstein *et al.*, 1982; Sniezek, 1990; Yates, 1990; Griffin and Tversky, 1992). However, this conclusion is drawn on those studies which used mainly students as subjects. This finding cannot be generalised to expert judges when they make judgments on those tasks of their expertise. As students usually do not possess this expertise, an expert's confidence is therefore expected to be more appropriate than a student's. Nonetheless, the results of the studies examining the appropriateness of experts' confidence were mixed.

Some types of experts were found overconfident when making judgments on the tasks of their expertise. These experts included medical doctors (Christensen-Szalanski and Bushyhead, 1981; Christensen-Szalanski, Beck, Christensen-Szalanski, and Koepsell, 1983), clinical psychologists (Oskamp, 1962; 1965), psychology

graduate students responding to questions about psychological propositions (Lichtenstein and Fischhoff, 1977), and bankers when predicting stock market movements (Stael von Holstein, 1972). The findings of overconfidence among these types of experts are consistent with the results of the extant literature in psychology examining mainly students' judgments as just mentioned. One phenomenon observed in these studies is that the subjective certainty in some types of these experts was often not justified by the active accuracy of their judgments. The increase in their confidence was found to be much higher than the improvement of their predictive accuracy, thus leading to overconfidence (Oskamp, 1962; 1965).

Some experts, when performing tasks within the scope of their expertise, were found to have relatively appropriate confidence. For example, auditors were found to have fairly appropriate confidence (Tomassini *et al.*, 1982; Solomon *et al.*, 1985; Dilla *et al.*, 1991; Mladenovic and Simnett, 1994; Simnett, 1994) due mainly to their extensive job-related training and the legal liability resulted from their inappropriate confidence (the literature of auditors' confidence will be discussed in detail in Section 3.3.11 of Chapter III). Weather reporters (Murphy and Brown, 1984) and economists (Braun and Yaniv, 1992) were also found to have relatively appropriate confidence for the reasons of having extensive training and timely feedback. Therefore, the appropriateness of judges' confidence is determined not only by the judges' expertise knowledge of a task, but also by the specific task nature and the match of the judges' knowledge and the task.

2.5.13.5 Conceptual and Methodological Issues

Keren (1991) raised several conceptual and methodological issues related to calibration studies. For example, Keren questioned about a major assumption adopted in previous calibration studies that people follow strict rules derived from

normative models when processing probabilistic information. Keren (1992) pointed out that normative decision theory assumes a decision maker as ideal and not confined by natural human limitations such as his/her limited memory and information processing capacity and vulnerability to both emotional and motivational states. Therefore, human limiting factors should also be taken into consideration when developing realistic decision models.

Another conceptual issue raised by Keren (1991) was the problem of different definitions of probability adopted by different researchers. Unfortunately, there is no compromise on the best definition up to now. For this reason, there is a lack of an unambiguous acceptable yardstick to which observed probabilistic assessments can be compared.

Keren (1991) proposed to classify calibration studies according to two perspectives: the strict view and the loose view. In the strict view, probability assessments are appraised by precise and rigorous criteria derived from a normative model. Therefore, uncertainty is external to the human assessor. In the loose view, the processes underlying probability judgments are continuous and iterative rather than sequential. These processes consist of mutual adjustments in the cognitive system resulting in a strength of belief that is then translated into a subjective probability. Therefore, this approach assumes that uncertainty is an internal attribute of the assessor in which the cognitive system plays a central role.

The concepts of relatedness and essential similarity are particularly relevant to this loose view. Related events share common characteristics. Consequently the information relevant to assessing the probabilities of these events is drawn from the same data base. Only related or essentially similar events are justified for using a frequentistic criterion for assessing calibration.

Some methodological issues related to the two perspectives of classifying calibration studies as defined above were discussed. In the strict view, probability judgments should be invariant to the method by which they were elicited. Thus factors like number of alternatives, choice versus no-choice procedures, framing and response mode are irrelevant to these judgments. On the other hand, the loose view assumes human beings having a dynamic cognitive system which is characterised by a limited human information processing capacity. Therefore, elicitation methods are expected to have significant effects on human judgments. Also, this view recognises that individual differences may have significant impacts on probability assessments.

Another methodological issue is the impact of social environments under which a calibration study is conducted. Some researchers (e.g., Dawes, 1980) suggested that people tend to overestimate their intellectual abilities, which leads themselves to have overconfidence. This overconfidence effect may be more pronounced when the assessors hold some control of a task.

Ideally, any complete evaluation of calibration studies should include separate analyses of the individual assessors and items respectively. However, if analysis is performed separately on each assessor, a large number of observations from each individual are necessary to have reliable results. Obtaining a large number of observations from subjects entails practical difficulties. In particular, subjects may get bored and become indifferent to the prediction tasks after a certain number of assessments, and sometimes even provision of some incentives may not be able to keep them motivated.

Finally, Keren (1991) suggested two possible explanations for the item difficulty effects. First, if an assessor is explicitly instructed not to use probabilities below 50%, as the task becomes more difficult, the extent of overconfidence increases. This suggests a built-in mechanism of the measurement scale without any

psychological substance. Second, a laboratory setting creates an expectation of an intermediate level of difficulty which may be anchored, and adjustments away from the anchor are usually not sufficient, leading to underconfidence (overconfidence) for easy (difficult) tasks.

In summary, appropriateness of confidence has been recognised to be a finer approach to measuring the performance of people's probabilistic judgments. Overconfidence was a robust phenomenon in this line of research. However, most of the studies in this research area examined students' probabilistic judgments on general knowledge questions. Many factors affecting the degree of overconfidence have been found in previous studies, including task factors, the judgment environments of a task, and the individual differences of judges. Various methods have been proposed to promote more appropriate confidence, but further studies are still needed to determine the relative effectiveness of each method.

Although the overconfidence effect was a robust phenomenon among students' probabilistic judgments, the literature of the appropriateness of experts' confidence was conflicting. While some studies showed that some specific types of experts were vulnerable to the same shortcomings as novices, the other studies did suggest clear superior among some other types of experts over novices. These results indicate that our understanding of the appropriateness of people's confidence is still only in its infancy.

A number of conceptual and methodological issues related to this line of research have not been resolved yet. These issues will be the challenges and agendas for researchers interested in this area. Although a large number of studies were found in this line of research, little is known about the relationships among appropriateness of confidence, the base-rate fallacy and the NC trait of judges. The current study attempts to provide a further link among these factors in a specific decision context.

2.6 Contingent Decision Behaviour

2.6.1 Overview

The focus of the Lens Model and the Heuristics-and-Biases frameworks is on comparing human judgments with some models and standards to determine the performance of these judgments. Therefore, judgment performance is one major dependent variable investigated within these two research frameworks. The framework of Contingent Decision Behaviour, however, focuses more on investigating how people select their decision strategies by balancing the desire to be accurate and the desire to conserve limited cognitive effort. One important dependent variable investigated within this research framework is therefore the decision strategies selected in a specific situation. Accuracy, being a measure of judgment performance taken as a dependent variable in the other two research frameworks, becomes one of the major independent variables in the framework of Contingent Decision Behaviour.

Payne and his colleagues (Payne, 1976; 1982; Bettman and Park, 1980; Johnson and Payne, 1985; Johnson, Payne and Bettman, 1988; Johnson and Schkade, 1989; Payne *et al.*, 1988; 1990a; 1993; Bettman *et al.*, 1990; Payne, Johnson, Bettman and Coupey, 1990b; Payne, Bettman and Johnson, 1992) adopted a micro-structural view to investigate human decision behaviour. They have contributed to understanding the causal mechanism underlying human behaviour in selecting among various decision strategies in different situations. A decision strategy is a sequence of mental operations used to transform an initial state of knowledge into a final goal state of

knowledge where a decision maker views a particular decision problem as being solved.

The remainder of this section intends to review the major findings of this research framework. First, the major factors affecting the contingent decision behaviour are identified. Second, each identified factor is discussed in more detail. Finally, the effects of effort and accuracy on the selection of decision strategies are investigated.

2.6.2 Factors Influencing Contingent Decision Behaviour

Three classes of factors are recognised as the major determinants for selecting a particular decision strategy among people. These factors are related to a problem, decision makers, and social context. Factors related to the problem include task variables and context variables. Task variables refer to those factors associated with the general structural characteristics of the decision problem, including task complexity, response mode, information display mode, and agenda constraints. On the other hand, context variables refer to those factors associated with the particular values of objects in the specific decision set under consideration, including the similarity and overall attractiveness of alternatives. In general, the values of context variables are more dependent on individual perceptions than the values of task variables. Factors related to decision makers include their cognitive ability, prior task knowledge, and expertise in a problem domain. Finally, factors related to social context include accountability and group membership.

In the rest of this section, the focus is on the review of the literature related to the task and context variables. No literature review will be provided for those factors related to social context, as the detailed literature on accountability, one major variable related to social context, has already been presented in Section 2.5.11.

2.6.3 Effects of Task Variables on Selecting Decision Strategies

2.6.3.1 Task Complexity

Although a substantial body of literature in psychology, management and social science has demonstrated the existence of the effects of task complexity on judgment performance, there is still a lack of a comprehensive definition of task complexity. In an influential paper in psychology, Wood (1986) defined task complexity as the description of the relationships among task inputs and among task inputs and outputs. The required acts and information cues in a task are two important task inputs, while task outputs include the products from completing the task, such as an audit report.

Wood suggested that task complexity could be measured by three analytical dimensions: component complexity, coordinative complexity and dynamic complexity. As the number of distinct acts that need to be executed in the performance of a task or the number of distinct information cues that must be processed in the performance of those acts increases, the component complexity of the task also increases. Coordinative complexity refers to the form and strength of the relationships between information cues, acts, the sequencing of inputs, and products. Specifically, coordinative complexity includes timing, frequency, intensity, and location requirements for performing the required acts. Dynamic complexity refers to the changes in either the set of required acts and information cues or the relationships between inputs and products can create shifts in the knowledge or skills required for a task, due to changes in the states of the world.

Bonner (1994) gave an even more comprehensive definition of task complexity and defined the overall task complexity as the amount and clarity of information at the input, processing, and output stages of a task. For example, the elements of input complexity related to amount of information include the number of alternatives a judge must evaluate, the number of cues or attributes per alternative, and the redundancy among cues. The clarity of input includes the clarity of specifying and the ability of measuring information cues, the match between the manner in which information cues are presented and the manner in which they are stored in their memory, and the presentation format of these cues. The amount of processing varies with the amount of input and the number of steps or procedures that have to be executed. The clarity of processing is the results of the extent of procedure specification and the nature of individual input-output relations. Finally, the amount of output refers to the number of goals or solutions per alternative, and the clarity of output depends on whether the goal is defined or specified clearly.

From the above discussion, the Bonner's definition of task complexity related to the input and processing stages of a task was rather similar to the Wood's. However, the amount and clarity of output in the Bonner's definition were ignored by Wood. Therefore, the Bonner's definition is considered as a more comprehensive one.

The elements of task complexity commonly investigated by researchers of the Contingent Decision Behaviour framework are the number of alternatives, the number of attributes, and time pressure. Their focus is on how these elements affect individuals' selection of their decision strategies. As the number of alternatives and attributes, and time pressure increase, the tasks become more complex. People are expected to adopt different decision strategies to cope with tasks of different degrees of complexity. These studies are reviewed below.

Several experiments have been conducted to investigate the effects of the number of alternatives on human behaviour in selecting decision strategies. It was found that decision strategy selection was sensitive to the number of alternatives (Payne, 1976; Bettman and Park, 1980). In particular, subjects were found to shift from compensatory to non-compensatory strategies as the number of alternatives increased (Payne, 1976). It was also found that processing decision problems with a large number of alternatives was generally more attribute-based early in the process, and more alternative-based later in the process (Bettman and Park, 1980).

The effects of the number of attributes on the selection of decision strategies were mixed. Payne (1976) and Olshavsky (1979) found no effect on the selection of decision strategies as the number of attributes increased. Sundstrom (1987), however, found an increase in the use of non-compensatory strategies with an increase in the number of attributes. Therefore, this issue has not been concluded yet.

Time pressure increases as less time is available to complete the tasks. Different degrees of time pressure are expected to have different effects on how people select decision strategies. It was found that under a mild degree of time pressure, people tended to accelerate processing such that the amount of time spent on processing each item of information decreased (Miller, 1960; Ben Zur and Breznitz, 1981; Payne *et al.*, 1988). When time pressure further increased, people tended to select only a subset of the most important information (Miller, 1960), with more weight being placed on negative information about alternatives (Wright, 1974; Wright and Weitz, 1977; Ben Zur and Breznitz, 1981; Payne *et al.*, 1988). Under high tension of time pressure, people tended to shift from compensatory to non-compensatory decision strategies (Miller, 1960; Janis and Mann, 1977; Ben Zur and Breznitz, 1981). Under extremely severe time pressure, people tended to use more attribute-based processing in decision-making (Payne *et al.*, 1988).

2.6.3.2 Response Mode

One fundamental principle of rational decision theory is procedure invariance which stipulates that strategically equivalent ways of eliciting a decision maker's preferences should result in the same revealed preferences. It was, however, found that variations in response mode caused a fundamental change in the way people processed information and thus led to different preferences in choices (Lichtenstein and Slovic, 1973). Reasons have been proposed for explaining the phenomenon of preference reversals. For instance, it was suggested that additional mental operations were needed for non-compatibility between response modes and information, which often increased effort and error, and might reduce the impact of those important attributes (Slovic, Griffin and Tversky, 1990). It was also argued that the phenomenon of preference reversals was due to the use of reframing and an anchoring and adjustment strategy, which led to different value assessments across response modes (Johnson and Schkade, 1989).

2.6.3.3 Information Display Mode

Information display mode was also found to have significant effects on the selection of decision strategies. Slovic (1972) found that people tended to use only the information being explicitly displayed in the stimulus object and use it only in the form in which it was displayed. In another study, Bettman and Kakkar (1977) found that information acquisition proceeded in a fashion that was consistent with display format. Jarvenpaa (1989, 1990) also found that graphical format differences accounted for a large portion of the variance in information acquisition and evaluation. Moreover, Johnson *et al.* (1988) found a lower rate of preference

reversals when probabilities were displayed in a simple form (e.g., 0.88 or 7/8) than when they were displayed in a more complex form (e.g., 399/456). All these studies supported the notion that people's selection of decision strategies is significantly affected by information display mode.

2.6.3.4 Agenda Effect

The last task variable discussed in this part is the agenda effect. This effect suggests that when people make a choice, constraints are placed on the order in which the elements of a choice set are considered by them. Hauser (1986) suggested that even if no constraints were imposed externally, a decision maker might self-impose an agenda on the order of selecting or eliminating choice alternatives. This was considered to be a method for simplifying cognitive processing and thus saving cognitive effort.

2.6.4 Effects of Context Variables on Selecting Decision Strategies

There is a growing body of literature that recognises people's selection of decision strategies as a function of context variables. The most important context variables affecting people's selection of decision strategies include similarity of alternatives and the framing effect. Since the framing effect has been discussed earlier in Section 2.5.8, this section only discusses the literature of similarity of alternatives.

Similarity was found to affect the information-processing strategies that led to choice. For instance, similarity was found to affect the ease of comparison between alternatives (Shugan, 1980; Tversky and Sattath, 1979). Payne *et al.* (1993) suggested that compensatory decision strategies were more likely to be used as the

alternatives were more similar. Their rationale was based on the cost of thinking hypothesis proposed by Shugan (1980), in which a relatively lower cost of thinking was suggested as a result of relatively few distinct dimensions needed to be considered among similar alternatives. It was also found that as the differences among alternatives on the attributes decreased, both the amount of information acquired in making a decision (Biggs, Bedard, Gaber and Linsmeier, 1985; Bockenholt, Albert, Aschenbrenner and Schmalhofer, 1991) and the total amount of time needed to make a decision (Stone and Schkade, 1991) increased.

2.6.5 Effects of Effort and Accuracy on Selecting Decision Strategies

One major focus of the framework of Contingent Decision Behaviour is on investigating how people select decision strategies by balancing decision accuracy and cognitive effort (Beach and Mitchell, 1978; Shugan, 1980; Klayman, 1983; Russo and Dosher, 1983; Johnson and Payne, 1985; Lipman, 1991). Cognitive effort has been recognised as a scarce resource (Simon, 1978). Therefore, the specific decision strategies being selected by decision makers will be the ones that can attain a desirable level of performance at the minimum level of cognitive effort (Wickens, 1986).

The most important issue in this research area is how to measure the cognitive effort expended on using different decision strategies. One approach is to describe decision strategies by a small set of elementary information processes (EIPs) common to a variety of tasks (Newell and Simon, 1972). This set of EIPs includes, for instance, such mental operations as reading a piece of information into short-term memory, comparing the values of two alternatives on an attribute, and multiplying a probability by a payoff. This set of EIPs can be taken as the operations used by decision makers to transform the initial state of problem knowledge into the final goal state (Holland,

Holyoak, Nisbett and Thagard, 1986). Under this approach, the cognitive effort for each decision strategy is the sum of the efforts for the various types of EIPs that are used to describe that decision strategy.

Based on this approach to measuring the cognitive effort required by different strategies, the question of how to balance the accuracy and effort in selecting a decision strategy can be explored. Bettman *et al.* (1990) trained seven subjects to use six different decision strategies to investigate this research question. A computer-based information acquisition system was used to monitor the subjects' information acquisition sequences. The subjects' performance was measured in terms of their response time and their self-reported decision difficulty (i.e., cognitive effort). The results indicated that their subjects took longer time to complete the tasks as the complexity of problem was increased by more alternatives or more attributes. They also found that the effects of task complexity on cognitive effort varied as a result of strategies. Interestingly, the estimates of the time taken for each EIP were essentially the same regardless of the decision strategy used. This finding was in line with prior studies in cognitive research (Groen and Parkman, 1972; Russo, 1978). It was, however, found that there were significant individual differences in the cognitive effort associated with individual EIPs, suggesting that individuals might choose different decision strategies in part because the same EIPs might demand different amount of effort across individuals.

Payne *et al.* (1993) suggested that the effort associated with individual EIPs should reflect the particular task environment from which they were derived. Therefore, they expected that the effort associated with individual EIPs varied as a result of task variables, such as information display format. These suggestions were in line with the empirical evidence of previous studies in this line of research (Johnson *et al.*, 1988; Stone and Schkade, 1991).

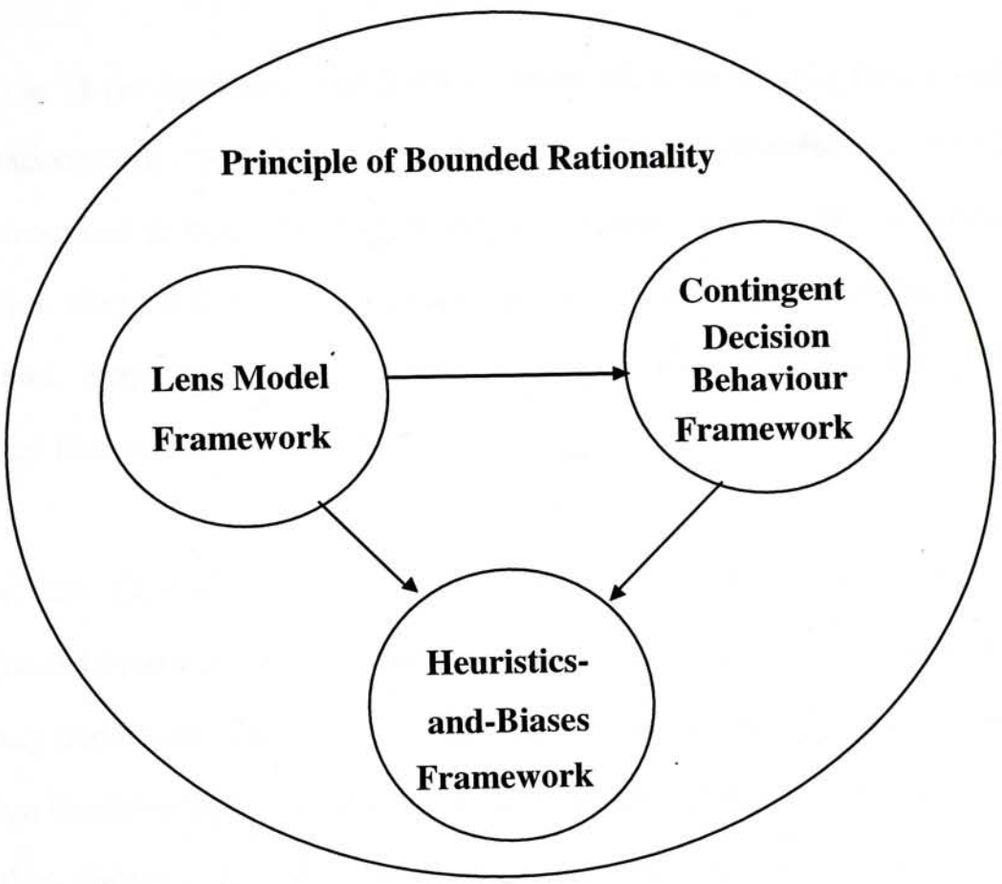
One important research issue of this framework is to investigate the reasons behind selecting a particular decision strategy under a particular task environment. People were found to be more likely to emphasise accuracy for important or irreversible decisions, when they were personally responsible for the outcomes of the decisions, and when accuracy was more salient than effort, such as when feedback was provided on accuracy but not on effort.

Constraints on effort were found when people were required to solve a complex problem, or when they were required to solve a problem under time pressure. In general, constraints on effort were more commonly found than constraints on accuracy. As mentioned earlier in Section 2.6.1, decision task environment is important for determining the selection of a decision strategy. Therefore, the most efficient decision strategies for a given set of accuracy-effort trade-offs will vary across different decision task environments.

2.7 Integrated Framework for Behavioural Decision Theory

Sections 2.3 to 2.6 presented four major areas of findings or ideas of BDT research for the past four decades in terms of one principle and three research frameworks. Although each principle or framework represented the research efforts contributed by a separate group of researchers who adopted a different approach to investigate human decision behaviour, the literature reviewed in these sections uncovered that this principle and these frameworks were not independent of each other. Many common features among them could be found. For example, some of the findings in one framework could be used to explain the findings of the others. This section attempts to explore the interrelationships among this principle and these frameworks, and to consolidate them into an integrated framework for future studies (see Figure 2.1).

Figure 2.1 Integrated Framework for Behavioural Decision Theory



2.7.1 Principle of Bounded Rationality and the Three Research Frameworks

The main thesis of the Lens Model framework is to use simple linear models to describe human decision behaviour. It was found that the prediction performance of the models of decision makers was in most cases better than the decision makers' judgmental performance. The major reason to account for this phenomenon is that

people are not consistent in making their judgments and their judgments are thus found to be suboptimal. The major findings of this framework fit in very well with the Principle of Bounded Rationality, in which people are recognised to have a limited information processing capacity. Therefore, their decisions are satisfactory rather than optimal.

The focus of the Heuristics-and-Biases framework is on investigating people's errors and irrationalities when they make judgments. The major reason for people making such errors and irrationalities is that they adopt heuristics to make judgments. These heuristics work well in most daily life, but lead to suboptimal solutions in certain situations. Similarly, the findings of this framework are in line with the Principle of Bounded Rationality.

Finally, the Contingent Decision Behaviour framework argues that the human decision behaviour of selecting decision strategies is determined mainly by balancing accuracy and effort. On the one hand, balancing accuracy and effort ensures that the decision is satisfactory. On the other hand, balancing these two factors reflects the fact that people's limited information processing capacity drives their decision behaviour. From the above discussions, all the major findings of these frameworks can be explained by the Principle of Bounded Rationality. Therefore, this principle has laid the foundations for the research of all these frameworks.

2.7.2 Lens Model and Heuristics-and-Biases Frameworks

The Lens Model framework can be used to explain some of the phenomena discovered in the Heuristics-and-Biases framework. In fact, heuristics can be taken as ways of human judgments based on models with limited validity. For example, people use the representativeness heuristic to select a cue based on the degree of

perceived similarity or causal association between the cue and the criterion variable. The greater the perceived similarity or causal association between the cue and the criterion variable, the greater the likelihood that the cue will be selected. Therefore, the Lens Model framework simply refers the representativeness heuristic as overweighing a particular cue while neglecting other valid cues for inferring a criterion variable (Hammond, 1990).

A similar argument can be put forward for the anchoring and adjustment heuristic. Rather than ignoring some important cues in the representativeness heuristic, the Lens Model framework refers the anchoring and adjustment heuristic simply as overweighing a particular cue when it is taken as an anchor, while the other cues are under-utilised with insufficient adjustments for inferring a criterion variable.

The Lens Model and the Heuristics-and-Biases frameworks differ mainly in their research focuses. The Lens Model framework emphasises achievement, that is, the correlation between human judgments and the actual outcomes of a criterion variable, whereas the Heuristics-and-Biases framework focuses on identifying the errors and irrationality of human judgments (Hammond, 1990).

2.7.3 Lens Model and Contingent Decision Behaviour Frameworks

The Lens Model framework can be thought of as a model for identifying the trade-offs between accuracy and effort in determining the decision strategies selected by decision makers in the Contingent Decision Behaviour framework. In explaining the accuracy-effort trade-offs, the selection of decision strategies can be taken as a criterion variable in the model, whereas the accuracy requirement and cognitive effort are taken as the environmental cues. The trade-offs of these two cues are specified in a function specified in the model, though this function is not necessarily linear. The

question of how well a linear function represents these trade-offs remains an empirical issue.

2.7.4 Heuristics-and-Biases and Contingent Decision Behaviour Frameworks

The Contingent Decision Behaviour framework can be used to explain some "irrational" human decision behaviour found by researchers of the Heuristics-and-Biases framework. Decision strategies being selected under this framework can be considered to be efficient heuristics, which provide a satisfactory level of accuracy with substantial savings in effort under certain decision environments (Thorngate, 1980). The specific strategies being selected depend on whether decision makers emphasise accuracy more or cognitive effort more, and whether there are any constraints imposed on these two elements.

2.8 Chapter Summary

This chapter reviewed the literature of behavioural decision theory (BDT) developed by psychology researchers over the past four decades. The literature uncovered that the Principle of Bounded Rationality (Simon, 1955) laid the foundation for the direction of BDT research during this period. Based on this principle, three major research frameworks were developed in this area. Being developed from the Brunswik's lens model, the Lens Model framework received the earliest attention from psychology researchers, and its main thesis focuses on the linear modelling of judgments. The Heuristics-and-Biases framework was founded in the 1970's by Tversky and Kahneman, which emphasises the errors and irrationalities of people when making judgments, and investigates the various means to improve the performance of human judgments. The Contingent Decision Behaviour framework,

being developed by Payne, Bettman and Johnson at around the same time but forming its shape only in recent years, contends that human decision behaviour is adaptive to the task nature, and the selection of decision strategies depends mainly on balancing the expected decision accuracy and the required cognitive efforts expended by decision makers.

Although these research frameworks have been developed separately by different groups of researchers who emphasised different aspects of human decision behaviour, the literature of BDT reviewed in this chapter uncovered that these frameworks were not independent of each other. It was found that there were many common features among these frameworks. Some of the findings in one framework could be explained by using the findings of the others. These common features, if fully understood, could be consolidated into an integrated framework. This integration, in turn, could contribute to developing better theories on human decision behaviour which has not been explained fully by the existing theories.

The aim of the current study is to investigate the judgmental performance and the biases of bank loan officers when predicting the probabilities of firms being in financial distress. Since financial distress prediction is a task of probabilistic judgment, the literature of the Heuristics-and-Biases framework is particularly relevant to the study's research problems. Specifically, the current study intends to examine the extent that the relevance of base-rate information, the perceived informativeness of case-specific evidence, and the need of cognition trait of individual bank loan officers would affect the appropriateness of their confidence. As such, this study offers a further link between the base-rate fallacy and the overconfidence effect within this framework. The findings in the other two research frameworks and the Principle of Bounded Rationality can also be used to illuminate the results of the current study.

BDT is concerned with human decision behaviour in general. The literature of the overconfidence effect was concentrated on the general, rather than decision-specific issues. Furthermore, most of the theories in this research area have been developed from experiments using students as the subjects of study. Therefore, the external validity of the results of these experiments is subject to some criticism. These theories have in fact provided many opportunities for explaining human decision behaviour in accounting and auditing contexts. The next chapter will review the literature of behavioural decision research in accounting and discuss the specific motivations and rationale for developing the research model and hypotheses of the current study.

CHAPTER III

LITERATURE REVIEW ON BEHAVIOURAL DECISION RESEARCH IN ACCOUNTING

3.1 Introduction

This chapter provides a detailed literature review on those accounting studies that applied the major ideas or findings of behavioural decision theory (BDT) as discussed in Chapter II. This line of accounting research is generally called behavioural decision research (BDR) in accounting or behavioural accounting research, and is considered to be the immediate research discipline of the current study. Specifically, the current study relates to BDR in accounting that investigates the performance of financial distress predictions by bank loan officers. This specific research area is called BDR in financial distress predictions in the current study.

In view of the large volume of literature of BDR in accounting and since the current study only attempts to investigate a few major biases which are related to the use of base-rate information and could affect the prediction performance of bank loan officers, this chapter focuses mainly on reviewing those studies of BDR in accounting that adopted the Heuristics-and-Biases research framework in BDT as discussed previously in Section 2.5 of Chapter II. It also reviews those studies that are related to BDR in financial distress predictions made by bank loan officers.

The remainder of this chapter is arranged around five sections. Section 3.2 first provides an overview on BDR in accounting, which highlights the major determinants of the performance of decision-making. Section 3.3 then reviews those studies on BDR in accounting that adopted the Heuristics-and-Biases framework (except those studies related to financial distress predictions by bank loan officers which will be

reviewed in Section 3.4). The sequence of major topics reviewed in this section follows those in the same framework as reviewed in Section 2.5 of Chapter II in order to facilitate comparison and development of the research model of the current study. Section 3.4 then reviews the literature of all BDR in financial distress predictions made by bank loan officers, including but not restricted to those studies that adopted the Heuristics-and-Biases framework. Section 3.5 discusses the motivation of the current study driven by several research opportunities identified from the literature reviewed. Finally, Section 3.6 provides a summary of the chapter.

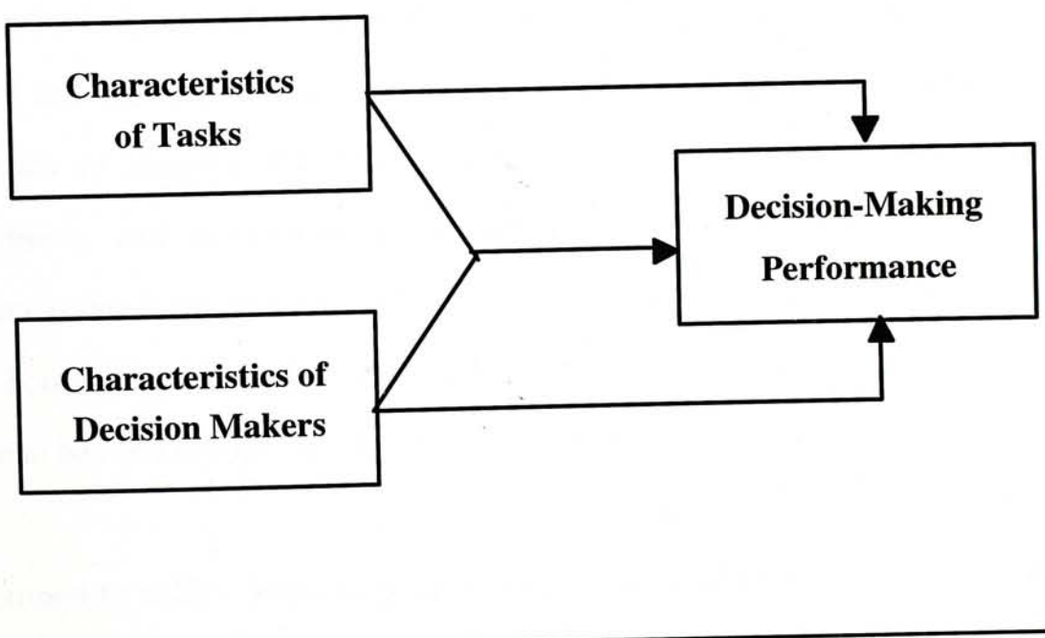
3.2 Overview of BDR in Accounting and the Major Determinants of Decision-Making Performance

As mentioned earlier in Section 2.2 of Chapter II, BDT is the study of how individuals make decisions (Hogarth, 1993). Since decision-making is an important topic for a variety of disciplines, BDT is therefore highly interdisciplinary and involves research efforts from areas such as psychology, economics, statistics, accounting, finance and marketing, to name just a few. BDR in accounting is the applied research of BDT in an accounting context, and focuses on three main issues: (1) how do accountants, auditors and users of accounting information make decisions about and with accounting information in a particular accounting-related task? (2) how well do they perform that particular task? and (3) how can they be helped perform better? (Hogarth, 1991).

The first issue addresses to understanding the decision-making processes. The second issue relates to the performance of decision makers. The third issue is concerned with the ultimate objective of this research area: to improve decision-making performance. To understand how to improve the performance of individual decision makers, it is necessary to identify the major determinants of their

performance. Two factors are commonly agreed among researchers in the area of BDR in accounting as being the crucial determinants of decision-making performance: the characteristics of tasks and the characteristics of decision makers (Figure 3.1) (Hogarth, 1991; Payne *et al.*, 1992; Gibbins and Jamal, 1993; Hogarth, 1993; Libby and Luft, 1993; Peters, 1993; Wright *et al.*, 1994). Task characteristics include the structure and content of the decision problems such as base-rate information in probabilistic judgments, and the environments in which the tasks are performed (see Chapter II for more detailed discussion of these characteristics). These environments, for instance, include incentives, accountability and decision aids adopted.

Figure 3.1 Determinants of Decision-Making Performance



The characteristics of tasks are considered to be a more important determinant for the performance of decision makers (Hogarth, 1991). The major reasons are that

people are more adaptive to the demand of the tasks. The cognition and behaviour of people are thus determined mainly by the tasks and their environments. However, the emphasis on the task effect does not mean that less attention should be paid to the influences of other factors, such as the characteristics of decision makers or the interactions of the characteristics of both the tasks and the decision makers. In fact, these interactions are always more important than each individual type of these characteristics considered (Gibbins and Jamal, 1993). This suggestion is consistent with the contingent approach proposed by Libby and Luft (1993), that the optimal performance is determined by a fit of task demand and decision makers' characteristics.

Regarding the characteristics of decision makers, ability, knowledge and motivation are particularly singled out as being the major factors that may affect their performance (Libby and Luft, 1993). Ability refers to the information processing capacity of decision makers and is largely task independent. People were found to have a limited information processing capacity (e.g., Miller, 1956; Simon, 1955; Simon and Newell, 1971). To cope with this limitation, people often employ heuristics to simplify the decision-making process. Availability, anchoring and adjustment, and representativeness are the three heuristics that people most commonly use (see Sections 2.5.2, to 2.5.4 for more detailed discussion of these three heuristics). These three heuristics are important for BDR in accounting because they can be used to explain some decision behaviour in accounting settings.

In contrast to ability, knowledge relates specifically to a particular task. One major reason why knowledge is examined in accounting research is to identify the differences in knowledge between novices and experts. The understanding of these differences can help find out better ways to impart the knowledge of experts to novices. Also, understanding the knowledge requirements of each task is important

for properly assigning people with proper knowledge to the right tasks at minimum costs.

The last characteristic of decision makers that affects their performance is their motivation. This characteristic accounts for the willingness of decision makers to expend effort (Libby and Luft, 1993). Motivation is determined jointly by the characteristics of tasks and the other characteristics of decision makers. For example, incentives, accountability, social pressure, the desire to preserve self-esteem and the desire to understand the environment are such characteristics that may cause decision makers to exert more effort. An increase of effort may lead to better performance, no change in performance, or even poorer performance depending on the conditions of tasks and decision makers (Libby and Luft, 1993).

When decision makers use a relatively low effort information processing strategy, when they know the current strategy is insufficient, and when they know that a better strategy is available and they believe that this strategy can be used, increased effort will lead to better performance (Johnson and Kaplan, 1991). When some decision errors are the result of cognitive mechanisms not under conscious control (Camerer, Loewenstein and Weber, 1989) or the result of a dominant factor such as the desire to avoid criticism by others (Simonson and Nye, 1992), these errors are not sensitive to changes in effort. Increased effort on flawed strategy may lead to poor performance (Paese and Sniezek, 1991). It is therefore important to understand whether a task is effort-sensitive before ways to improve performance can be suggested.

Since the current study focuses on some decision errors in accounting judgments, the accounting studies that addressed the use of heuristics and the commitment of judgment biases are particularly relevant and are thus first reviewed in Section 3.3.

This review, in turn, will provide a clearer picture of the major determinants of decision-making performance as discussed in this section above.

3.3 Heuristics and Biases

3.3.1 Overview

A substantial body of descriptive literature in BDT suggests that people in general use heuristics in their everyday judgments. These heuristics are, by and large, developed from their experience and work very well in many simple judgmental tasks. These heuristics, however, do not follow the prescriptive rules and may lead to biases in some situations. This line of research has been conducted mainly by psychology researchers, using students as the subjects of study. The generalisation of the findings from these studies to applied disciplines such as accounting should be empirically verified by using real subjects and more realistic settings.

Accounting and auditing judgments mainly involve experts who have different motivations when dealing with specific types of tasks. Although experts in accounting and auditing may also be susceptible to committing similar biases as those committed by college students, two major questions remain to be answered by empirical studies: (1) whether the expertise possessed by accounting information users affects their tendency to commit such biases, what the extent of these biases is, and what effect the specific task nature together with the accounting information users' motivation would have on these biases; and (2) whether committing these biases will seriously affect their decisions and actions. The following review attempts to provide some insights into these questions.

Similar to the review on the Heuristics-and-Biases framework in Section 2.5 of Chapter II, this section first reviews those accounting studies that addressed the use of the three heuristics (i.e., the availability, anchoring and adjustment, and representativeness heuristics) and then those studies related to the commitment of various judgment biases. This section, however, excludes those accounting studies that examined the decision behaviour of bank loan officers when predicting the probabilities of firms being in financial distress. These studies will be discussed in detail in Section 3.4.

3.3.2 Availability Heuristic

Availability is a heuristic adopted by a decision maker to evaluate the frequency or probability of an event by the relative number of pro versus con reasons generated, or by how easily such reasons can be generated (see Section 2.5.2 of Chapter II for more detailed discussion). Auditors and financial statement users may be susceptible to using this heuristic in a number of accounting decision situations. Several accounting studies were found to address this issue and these are reviewed below.

Libby (1985) conducted an experiment to investigate whether auditors relied on how easily unexpected fluctuations in financial ratios could be generated in their minds to identify potential financial statement errors during analytical review. Auditors were randomly assigned to two treatment groups and a control group. Auditors in one treatment group were provided with an inherited cue chosen from the sales and receivables cycle, whereas auditors in the other treatment group were provided with an inherited cue chosen from the purchases, inventories and payables cycle. Auditors in the control group received no inherited cue. The results suggested that financial statement errors recently experienced, perceived to occur more frequently, or actually detected to be more frequent were more likely to be generated as initial hypotheses.

In addition, an inherited hypothesis increased the likelihood that subsequent hypotheses were generated from the same cycle. Finally, the results revealed that generation of a hypothesis from one transaction cycle increased the likelihood that the subsequent hypothesis was also generated from the same transaction cycle.

Hoch (1984) showed that people sometimes relied on availability as a cue to make judgments. Moser (1989) extended Hoch's findings to investors' earnings forecasts. Fifty-eight investors were asked to think of supporting and opposing arguments about the earnings prospects of a stock and to assess the likelihood that its earnings would increase by a certain percentage over the next 12 months. Subjects were randomly assigned to one of four between-subjects groups determined by crossing two independent variables. One independent variable was the order of reason generation which was manipulated on two levels. On the one level, subjects were first asked to list the reasons why the earnings would increase, and then list the reasons why the earnings would not increase. The order of reason generation on the other level was reversed. The other independent variable was the amount of external information which was manipulated as either low or high. Subjects in the low-amount group were given only the name of a company, whereas subjects in the high-amount group were given both the company name and its financial statements. The results revealed that differential availability of supporting and opposing arguments affected investors' probability judgments on the future earnings forecast for a company. It was also found that accessibility of financial statements did not reduce the availability effect on investors' earnings judgments.

Anderson, Kaplan and Reckers (1992) extended Moser's study to investigate the availability effect on analytical review. Audit managers were presented with a scenario in which the client's unaudited financial statements exhibited a significant change in inventory turnover. After reading the case materials, half of the subjects were asked to first generate non-error explanations and subsequently generate error

explanations; the rest of the subjects were asked to generate explanations in the reverse order. Subjects were also asked to evaluate the likelihood that the ratio change was primarily caused by an error or non-error. The results showed that the subjects who listed error explanations second generated significantly fewer error explanations than those who listed error explanations first. These results were consistent with the predictions of the output interference theory that focusing first on non-error explanations interfered with an auditor's ability to subsequently generate error explanations. However, the subjects' likelihood assessments were not associated with the number of errors and non-errors generated.

In summary, there were only a limited number of accounting studies that investigated the effect of the availability heuristic on accounting judgments. The results of these studies were in general consistent with the findings of psychology studies. Auditors and investors were found to use the availability heuristic to make judgments. The results of Anderson *et al.* (1992), however, indicated that the auditors' likelihood assessments for the relationships between the change of ratio and the cause of an error in analytical review were not consistent with the availability heuristic. Therefore, further studies are warranted to resolve these differences.

3.3.3 Anchoring and Adjustment Heuristic

The anchoring and adjustment heuristic is a general judgment process by which individuals focus on an initial value (an anchor) in a decision setting and arrive at the final answer by adjusting from that value based on additional information available. Such adjustments from the anchor were often found to be inadequate (see Section 2.5.3 for more detailed discussion). Evidence is usually received sequentially in a typical audit setting. Therefore, auditors may be susceptible to the anchoring bias.

Several studies were found to investigate this bias in accounting and audit judgments. These studies are reviewed below.

Joyce and Biddle (1981a) conducted a series of experiments to investigate whether experienced auditors used the anchoring and adjustment heuristic in making audit judgments. In Experiments 1A and 1B, auditors were asked to estimate the incidence of significant management fraud by first being given different anchors in terms of the numbers of management fraud incidents that they had come across in their previous audit assignments. The results strongly supported the presence of the anchoring bias. However, when the experimental tasks were more similar to typical audit settings than the task in the previous experiments, auditors were not found to commit this bias. In Experiments 2A and 2B, Joyce and Biddle gave another group of auditors a list of accounting controls for one part of a client's operation, and asked them to rate the extensiveness of audit tests to be performed. Two of the accounting controls were then deleted, and the subjects were asked again to rate the extensiveness of audit tests to be performed. Contradictory to the results of the previous two experiments, the results of both Experiments 2A and 2B suggested that auditors' adjustments were appropriate, supporting the notion that auditors were conservative in conducting audit assignments.

In another study of investigating the anchoring bias in analytical review, Kinney and Uecker (1982) asked a group of auditors to indicate a range of values for a given gross profit percentage within which no investigation should be tendered. The anchoring bias was found among those auditors who provided significantly different ranges of values depending on the value of a given anchor. The estimated ranges were found to be too close to the given anchors. However, the results also showed that more auditors in the high-anchor group indicated more investigations than those in the low-anchor group. Therefore, these results suggested that auditors were less willing to accept the financial data indicating economic improvement than the

financial data indicating economic decline, which was consistent with the findings of conservatism among auditors in Joyce and Biddle's Experiments 2A and 2B. Kinney and Uecker concluded that auditors' judgments were affected by both the given anchors and their conservative tendency.

Biggs and Wild (1985) modified Kinney and Uecker's study by making the experimental task more representative of audit tasks in practice. Biggs and Wild added two treatment conditions that provided a group of auditors with the financial data for the past five years (instead of only the financial data for the past two years in Kinney and Uecker's experiment). The results corroborated the major finding of Kinney and Uecker's study in that auditors' judgments were biased in the direction of an unaudited value. However, the anchoring effect was mitigated when auditors were provided with a large and more realistic data set.

Butler (1986) used three different anchors to examine auditors' direct risk assessments on the collectibility of outstanding accounts receivables. Subjects were given an allowable risk for incorrectly accepting a given account balance as reasonable, and were asked to assess the true risk on the basis of a given sample of data. The results provided limited support for the anchoring bias among auditors. Only the low-anchor response was consistent with a strict anchoring process. In the high-anchor condition, the subjects' mean response indicated an over-adjustment, and in the middle-anchor condition, the auditors' response was in the wrong direction. Butler attributed these results to a low internal anchor which auditors might have brought to the task.

Butler's suggestion as to the existence of internal anchors among auditors was tested by Morris (1993) who asked a group of auditors to examine the collectibility of some receivables and the sufficiency of the related allowance for doubtful accounts. Subjects were provided with a piece of positive evidence and a piece of negative

evidence in two different orders. Experienced auditors were contended to have a negative internal anchor, owing to potential legal liability and professional scepticism. This contention was supported by the results that showed a primacy effect among those auditors who were given negative and then positive evidence, and a recency effect among the others who were given positive and then negative evidence. It was also found that the existence of a negative internal anchor caused auditors to rank the source containing negative information as relatively more important in their judgments.

In summary, there are three major findings in the accounting studies that examined the anchoring and adjustment heuristic. First, auditors were found to use an anchoring and adjustment process to update their belief to a lesser extent than subjects of previous psychology studies. Second, auditors' judgments were affected not only by an anchor, but also by their conservative tendency which was shaped by their environment of potential legal liability and professional scepticism. Third, experienced auditors might have developed their internal anchors through practice. The existence of such internal anchors among experienced auditors might account for their conservatism.

3.3.4 Order Effects in Belief Updating

3.3.4.1 Overview

The theory of belief-adjustment proposed by Hogarth and Einhorn (1992) assumes an anchoring and adjustment process in which evidence is evaluated sequentially (see Section 2.5.7 of Chapter II for detailed discussion). An audit judgment is recognised to be a continuous process of receiving information (including feedback from

previous actions), and then choosing to act or not to act (Gibbins, 1984). Therefore, research on the order effects in belief updating is particularly suitable for auditing tasks. In fact, this theory has a significant impact on the research area of audit judgments (e.g., Ashton and Ashton, 1988; 1990; Butt and Campbell, 1989; Knechel and Messier, 1990; Tubbs, Messier and Knechel, 1990; Asare, 1992; Messier, 1992; Pei, Reed and Koch, 1992a; Krull, Reckers and Wong, 1993; McMillan and White, 1993). Research on the order effects in belief updating is also found in management accounting (e.g., Dillard, Kauffman and Spires, 1991) and taxation (e.g., Pei, Reckers and Wyndelts, 1992b) contexts, although research in these contexts did not attract the same attention as it did in audit judgments.

Three issues have been addressed by the accounting studies in this research area: (1) do the order effects in belief revision for auditing and accounting tasks follow the models' predictions? (2) what are the impacts of these order effects on accounting decisions and actions? and (3) what are the major factors that could affect these order effects? Studies related to these issues are reviewed below.

3.3.4.2 Model Predictions

Ashton and Ashton (1988) conducted five experiments to test the belief-adjustment models proposed by Hogarth and Einhorn (1992). In Experiments 1A and 1B, auditors were first given as anchors three initial estimates of the likelihood that the client's internal controls would prevent or detect material errors. Subjects were then given four pieces of consistent evidence and were asked to investigate whether the client's payroll records were correct. In Experiments 2A and 2B of a payroll scenario and an accounts receivable scenario, auditors were instead given mixed evidence. In Experiment 3, the effects of the two presentation modes, including Step-by-Step (SbS) and End-of-Sequence (EoS), on belief revision were examined. The results

were consistent with the models' predictions of no order effects for consistent evidence, but a recency effect for mixed evidence. The results also showed that smaller (larger) anchors were adjusted upward (downward) more by positive (negative) evidence. Furthermore, the results showed that given the same evidence, simultaneous processing of the evidence led to a smaller belief revision than sequential processing. Finally, subjects were found to revise their belief to a greater extent when they received evidence contradictory to their current belief. The two experiments that related to consistent evidence were replicated by Ashton and Ashton (1990) in their Experiments 1 and 2 and similar results were obtained.

Tubbs *et al.* (1990) used two scenarios of the collectibility of accounts receivable and the fairness of accounts payable, to test the models' prediction. Again, the results indicated no order effects for consistent evidence as predicted. When two pieces of mixed evidence were evaluated, the predicted recency effect occurred only in the SbS response mode, but not in the EoS response mode. When four pieces of mixed evidence were evaluated, recency occurred in both response modes. Therefore, the contradictory result of no recency effect when evaluating two pieces of mixed evidence and in the EoS response mode might be attributed to the small quantity of evidence given to the subjects.

In investigating the recency effect in the different setting of a performance audit for a social programme, Pei *et al.* (1992a) presented two case scenarios to a group of state auditors. The results showed a significant recency effect for the mixed evidence given, as predicted by the model. The belief adjustments of the subjects were, however, found to be more affected by positive evidence than negative evidence, which was inconsistent with the findings of conservatism among financial auditors as suggested by Ashton and Ashton (1988) and Tubbs *et al.* (1990).

3.3.4.3 Order Effects on Effectiveness

Given the pervasiveness of the recency effect in accounting judgments, there has been a growing concern over this effect on the effectiveness of corresponding accounting decisions and actions. Three studies (Dillard *et al.*, 1991; Asare, 1992; Messier, 1992) were found to address this important issue. For instance, Dillard *et al.* (1991) asked a group of students to decide whether actions were justified based on the evidence in four generic and four management accounting scenarios. The results showed that a significant recency effect was found for the mixed evidence given, but this recency effect did not affect the subjects' decisions.

Similarly, Messier (1992) conducted two experiments in two different audit scenarios. In addition to revising their belief after receiving each piece of evidence, auditors were asked to make decisions in each scenario. For example, in investigating the judgments for the presentation of accounts payable, subjects were also asked to indicate the total budgeted hours for the additional work proposed. Similarly in a going-concern judgment scenario, subjects were asked to estimate the likelihood judgments about issuing a modified audit report. The results of both experiments were consistent with the predicted recency effect for mixed evidence, but the order of evidence was not found to have any effect on decisions.

Asare's (1992) study on a similar task of going-concern judgments produced a different picture of the order effects on audit decisions. The results indicated that the order in which evidence was received by auditors affected their audit consensus. In view of the mixed findings of the order effects on audit effectiveness and the importance of this issue, further research is warranted to reconcile the differences between the results in previous accounting studies. Future research should also attempt to identify the factors that could affect this relationship.

3.3.4.4 Factors Affecting the Order Effects

Several accounting studies were found to examine the major factors that could affect the order effects in belief revision, including prior belief, hypothesis-testing strategy, experience of the subjects, clients' preference, source reliability, information search behaviour and hypothesis framing.

The effects of prior belief and hypothesis-testing strategy on the order effects in revising belief were examined by Butt and Campbell (1989). Auditors were asked to evaluate the likelihood that an internal control would prevent or detect a material error. Prior belief was manipulated by varying the background material as either a positive or negative evaluation of a company. Hypothesis-testing strategy was manipulated as confirming, disconfirming or neutral strategy. Nonetheless, the results only found a marginally significant three-way interaction among the evidence order, prior belief and hypothesis-testing strategy. In the low-prior-belief group, the recency effects were found among the subjects in the confirming and neutral groups, but not in the disconfirming group.

Krull *et al.* (1993) further investigated the effect of prior belief, together with experience on the order effects in belief revision, in a task in which auditors were asked to assess the need for writing down the client's existing inventory due to obsolescence. Prior belief was operationalised as the likelihood of fraudulent financial reporting. Similar to Butt and Campbell, only a significant interaction effect was found. When presented with a mixture of evidence, the more experienced audit managers exhibited a greater recency effect than the less experienced ones.

Pei *et al.* (1992b) also investigated the effect of experience, together with the client's preference for a particular tax treatment, on the order effects in belief revision. The

task was a study of the professional tax preparers' judgments on real estate tax reporting. The results showed a three-way interaction, in which the order effects were larger for experienced preparers than inexperienced preparers. However, experienced preparers were less affected by the client's preference than inexperienced preparers. The effect of experience on the order effects suggested by Krull *et al.* (1993) and Pei *et al.* (1992b) was, however, not found in the results of McMillan and White (1993) in an experiment that investigated auditors' evaluation of internal control.

The effects of source reliability and information search behaviour were investigated by Knechel and Messier (1990). Auditors were asked to assess the collectibility of some accounts receivables. Source reliability was manipulated as either a more or a less reliable source. Information search behaviour was manipulated as either the decision to terminate the evidence search at an earlier or a later stage. It was found that subjects who terminated the information search sooner had a significantly higher probability assessment only for those who were given positive evidence. It was also found that change in auditors' judgment was the largest for those who received more reliable, negative evidence.

The effect of hypothesis framing on the order effects in belief revision was examined in two studies (Asare, 1992; McMillan and White, 1993), but the results of these studies were mixed. In a series of four experiments investigating auditors' going-concern judgments, Asare (1992) manipulated hypothesis framing as either a failure or a viability condition. The results indicated that hypothesis framing did not have any effect on the order effects. However, in an experiment of internal control evaluation, McMillan and White (1993) found that the mean belief revisions for those auditors who favoured the error-framed hypothesis were greater than those who favoured the environmental (non-error-framed) hypothesis. In addition, source reliability was found to interact with the direction of evidence to affect the order

effects. Changes in auditors' judgments were the largest for those who received more reliable, negative evidence.

3.3.4.5 Summary of Accounting Research on the Order Effects in Belief Updating

Three major findings can be drawn from the accounting studies that examined the order effects in belief updating reviewed above. First, the predictions of the models proposed by Hogarth and Einhorn (1992) were strongly supported in accounting tasks. The recency effects were found among tasks with a sequential presentation of mixed evidence, but no order effects were found in tasks with a sequential presentation of consistent evidence. Smaller (larger) anchors were also found to adjust upward (downward) more by positive (negative) evidence.

Second, the results of the recency effects on decisions and actions were, however, mixed. While Dillard *et al.* (1991) and Messier (1992) did not find any impact of the order effects on accounting and audit decisions, Asare (1992) showed that the order of evidence affected auditors' consensus.

Third, some factors were found to affect the order effects in accounting tasks. Prior belief was found to interact with hypothesis-testing strategy to affect the order effects. The effects of subjects' experience and hypothesis framing on the order effects were fairly consistent. Information search behaviour was found to affect the order effects, in that subjects who terminated the information search sooner had significantly higher judgments on the collectibility of outstanding receivable balances only among those who were given positive evidence.

Although some of these factors were found to have significant effects on the order effects, their relationships were more complicated than those hypothesised. Future research should focus on developing better theories by using different tasks and adopting different research approaches to examine these relationships.

3.3.5 Conjunction Fallacy

The conjunction fallacy is the violation of the conjunction rule that compares the probabilities of the constituent events with the probability of their conjunction (see Section 2.5.5 of Chapter II for more detailed discussion). This fallacy will impair the effectiveness of an audit by predisposing auditors to generate incorrect hypotheses or explanations for particular types of financial statement errors. The major issue that accounting researchers should address is whether auditors commit to this fallacy similar to novice people examined in previous psychology studies, leading to systematic errors in judgments.

Unfortunately, only one accounting study was found to address the above issue. Frederick and Libby (1986) conducted a series of experiments to investigate how the auditors' knowledge interacted with current audit evidence to determine their judgment. They asked both experienced auditors and students to predict the implications of some internal control weaknesses on financial statement errors, by ranking the likelihood of individual account errors and the combinations of those account errors. They posited that students only had the knowledge of a double-entry generating process to identify the concurrence of certain pairs of account errors. Besides this knowledge, auditors had knowledge of the associations of internal control weaknesses with particular types of account errors. This knowledge difference, when functioning according to the feature-matching model, led to different patterns of the conjunction fallacy.

The results were consistent with Frederick and Libby's propositions of the feature-matching model and the knowledge differences between auditors and students. When both account errors were consistent with the prototypical outcome of the internal control scenario, auditors judged the account-errors conjunction to be more likely than either of its constituents, but students judged the account-errors conjunction to be more likely than one of its constituents. When only one of the two account errors was consistent with the prototypical outcome of the internal control scenario, both experienced auditors and students judged the conjunction to be more likely than one of its constituents. These results further demonstrated that the knowledge base of auditors needs to be taken into consideration when understanding auditors' judgments.

3.3.6 Framing Effect

The principle of description invariance states that the way a situation is described should not affect one's decision. As discussed earlier in Section 2.5.8 of Chapter II, the results of a number of psychology studies indicated to the contrary that individuals' choices were affected by changes in how a situation was described or framed (Loftus and Zanni, 1975; Bransford, 1979; Tversky and Kahneman, 1981; Loftus, 1982). This phenomenon is called the framing effect. Several studies investigated this effect in auditing and management accounting contexts with mixed findings, and these studies are reviewed below.

For example, Kida (1984b) conducted an experiment to examine whether auditors' going-concern judgments were affected by the way of problem framing. Subjects were randomly assigned to two different framing groups. Subjects in the failure-framing group were asked to determine if a firm was going to fail in the coming two

years, whereas subjects in the viable-framing group were asked to determine if a firm was going to remain viable for at least two more years. All the subjects were then asked to list the information from the firm descriptions that they considered to be relevant to their decisions, and to estimate the probabilities that their decisions were correct. Kida (1984b) found no significant difference in the number of failure items that were listed by both framing groups, but the subjects in the viable-framing group listed significantly more viable items than those in the failure-framing group. Also, the probability judgments between the two framing groups were found to be not significantly different from each other. Therefore, these results provided only weak support for the framing effect, which was consistent with the conservative approach adopted by auditors.

Trotman and Sng (1989) extended Kida's (1984b) study to a similar task of going-concern judgments, but with evidence presented sequentially. Auditors were first provided with prior expectation information, and were then asked to identify the relevant cues to account for their judgments. Subjects were randomly assigned to one of the eight between-subjects groups determined by crossing three independent variables. Hypothesis framing was manipulated in the same way as in Kida's (1984b) experiment. Prior expectation was manipulated as the likelihood of either failure or viability. Cue diagnosticity was manipulated as either high or low.

Trotman and Sng found a marginally significant interaction effect of hypothesis framing and prior expectation on the net number of failure cues (the number of failure cues minus the number of viability cues) that were considered to be relevant by the subjects in making their judgments. When prior expectation was strong, hypothesis framing was found to have a significant effect on the net number of failure cues identified. However, when prior expectation was weak, hypothesis framing was found to have no significant effect. It was also found that cue diagnosticity affected

auditors' judgments. These results further supported Kida's (1984b) conclusion of only weak support for the framing effect on auditors' going-concern judgments.

In examining the effects of alternative sample space representations on the accuracy of auditors' uncertainty judgment, Shields, Solomon and Waller (1987) manipulated the framing of sample space for accounts as either book value misstatements or audit values. They hypothesised that auditors organised their knowledge in memory as schemata that served as cognitive data bases about the uncertain quantity. The effect of different sample spaces on auditors' judgments depended largely on whether auditors used a single schema (or a set of closely related schemata) or separate schemata for different sample space representations. Contrary to the findings in psychology studies, Shields *et al.* (1987) did not find any significant difference in the accuracy of auditors' judgments between the two types of framing. They attributed this result to the type of subjects used in their experiment.

In a management accounting task of analysing a decision of variance investigation, Lipe (1993) found framing to have a significant effect on decision-making. Both business students and experienced business people were asked to evaluate the perceived benefits and the performance of an investigator when investigation expenditure was framed as either a cost or a loss. Both groups of subjects were found to perceive a benefit from framing the investigation expenditure as a cost, whereas no such benefit was perceived from framing the investigation expenditure as a loss. A similar result was also found in evaluating the performance of the investigator. A manager was rated more favourably when the investigation expenditure was framed as a cost than when it was framed as a loss.

In summary, studies that examined the framing effect on accounting judgments produced mixed results. While Lipe (1993) supported the framing effect in a management accounting context, Kida (1984b) provided only weak support for this

effect, and Shields *et al.* (1987) did not support the existence of this effect at all in an audit task. Perhaps Trotman and Sng's (1989) results provided a direction to reconcile these conflicting findings. They found that framing did not have a direct effect on auditors' judgments, but it interacted with some other factors, such as prior expectation in their study, to affect their judgments.

3.3.7 Confirmation Bias

Auditors need to gather and evaluate evidence for forming an opinion as to whether clients' financial statements are presented truly and fairly in accordance with generally accepted accounting principles. Throughout an audit process, auditors often inherit or generate diagnostic hypotheses to guide their search for evidence (Libby, 1985; Bedard and Biggs, 1991). Research in psychology found that individuals tend to search for evidence that confirms their hypotheses, and to evaluate evidence in such a way that their hypotheses are confirmed (Wason, 1960; Skov and Sherman, 1986; Higgins and Bargh, 1987; Klayman and Ha, 1989). This phenomenon is called the confirmation bias. If auditors follow such a way in gathering and evaluating evidence, the effectiveness of an audit process depends largely on the correctness of their initial hypotheses (Church, 1990).

Motivated by the potential threats of this bias on the audit profession, several accounting studies investigated whether experienced auditors may be susceptible to this bias found among student subjects in previous psychology studies. Some of these accounting studies were closely related to the accounting studies that investigated the framing effect, as reviewed earlier in Section 3.3.6. Although accounting studies that investigated both the confirmation bias and the framing effect might provide subjects with initial hypotheses in different types of framing, only those accounting studies that investigated the confirmation bias allowed their subjects to

generate their own initial hypotheses. Therefore, it is not difficult to find accounting research which addressed both issues in the same study.

In examining auditors' going-concern judgments, Kida (1984b) found no significant difference in the number of failure items listed by subjects in the two framing groups, but subjects in the viable-framing group listed significantly more viable items than those in the failure-framing group. In addition, the difference in the probability assessments between the subjects in the two framing groups was found to be insignificant. Therefore, these results provided only weak support for the existence of the confirmation bias among auditors.

Trotman and Sng (1989) extended Kida's (1984b) study to a task of going-concern judgments with evidence presented sequentially. The results indicated a marginally significant interaction effect of hypothesis framing and prior expectation on the net number of failure cues that were considered to be relevant by subjects for making their judgments. When prior expectation was strong, the hypothesis framing effect was significant. When prior expectation was weak however, the hypothesis framing effect was found to be insignificant. These results further supported Kida's (1984b) conclusion of there being only weak support for the confirmation bias.

In investigating the information-seeking behaviour in using analytical reviews for initial audit planning, Kaplan and Reckers (1989) asked a group of auditors to select error and irregularity questions and rank the first six questions selected. Conflicting results were obtained in that the number of error and irregularity questions selected by the auditors was not affected by the initial belief provided, nor by the experience of auditors. Kaplan and Reckers, however, found a significant interaction effect between the initial belief and the auditors' experience on the ranking of the question selected. For less experienced auditors, as the initial belief on the probability of

errors or irregularities increased, the perceived error weighting also increased. This relation did not hold among those auditors with more experience.

As mentioned earlier in Section 3.3.4.4, Butt and Campbell (1989) investigated the effects of hypothesis-testing strategy and prior belief on the confirmation bias. A group of auditors were asked to estimate the probability that a firm's internal controls would prevent or detect material errors. The results revealed that hypothesis-testing strategy had a significant effect on the confirmation bias only for those subjects who were given positive prior belief. The probability estimated by the subjects who were assigned to the confirming-strategy group was significantly different from that estimated by those in the other two groups. Therefore, the results also suggested weak support for the confirmation bias found among auditors.

Church (1991) investigated whether auditors who had committed to an audit task would be more likely to use a confirmatory strategy. Seventy-nine auditors were asked to allocate a particular number of budgeted audit hours to two transaction cycles, given that unexpected fluctuation was found in a firm's gross margin. Subjects were randomly assigned to two levels of commitment. In the strongly-committed group, subjects were asked to provide written arguments justifying why they selected a particular cycle. They were also told that their arguments would be discussed later with representatives from their offices or firms as part of a second research project. To heighten commitment, subjects' names and firm affiliations appeared at the top of the page on which they wrote their arguments. Subjects in the weakly-committed group were not asked to provide written arguments, nor were their names and firm affiliations included in the experimental materials. The results provided only weak support for the commitment effect. The strongly-committed subjects were found to allocate more hours to the cycle being selected than the weakly-committed subjects. The strongly-committed subjects were also found to assign more importance to the confirming cues than the weakly-committed subjects.

No difference, however, was found between the two commitment groups in assigning importance to the disconfirming cues, nor in recalling the disconfirming evidence.

In summary, the accounting studies reviewed in this section provided only weak support for the confirmation bias among auditors in a variety of audit tasks, including going-concern judgments, analytical review for initial audit planning, evaluation of internal control systems, and allocation of budgeted audit schedules. These robust findings could be explained by the same argument of conservatism among auditors.

3.3.8 Hindsight Bias

The hindsight bias is the tendency for individuals with outcome knowledge to claim that they would have estimated a probability of occurrence for the reported outcome which is higher than they would have estimated without the outcome information (see Section 2.5.6 of Chapter II for more detailed discussion). Several accounting studies were found to investigate the implications of this bias on accounting decision behaviour in the contexts of auditing and management accounting. These studies are described below.

Buchman (1985) asked a group of graduate students to make going-concern judgments. Subjects were randomly assigned to one of the four experimental groups determined by crossing two independent variables. The first independent variable was subjects' knowledge of bankruptcy which was manipulated as either foresight or hindsight. Type of audit opinion was the second independent variable and was manipulated as either unqualified or qualified audit opinion. The results indicated that the probability of bankruptcy estimated by the subjects in the hindsight group was higher than those in the foresight group. The type of audit opinion suggested,

however, was found to have no significant effect on the bankruptcy probability judgment.

Reimers and Butler (1992) examined the effect of a surprising outcome on the hindsight bias in two auditing scenarios of evaluating internal control and issuing of a qualifying opinion. A group of auditors were randomly assigned to one of the four experimental groups in each experiment: foresight, hindsight with no surprise, hindsight with surprise, and foresight with a decision aid. Surprise was manipulated as inconsistency between the evidence and the outcome, whereas no surprise was manipulated as consistency between the evidence and the outcome. The results suggested that the judgments made by the foresight group were different from that made by the hindsight with surprise group. The judgments made by the foresight group and the hindsight with no surprise group were, however, not significantly different from each other.

Anderson, Lowe and Reckers (1993) compared the judgments between auditors and the judges in a court case involving auditors. Fifty-eight auditors and 65 judges were asked to evaluate an audit engagement partner's decision not to book losses due to possible inventory obsolescence. In addition to the subject group, two more independent variables were examined. Environmental conditions were manipulated as either red flags or white flags. The inclusion of flag cues was to enhance the hindsight bias. Red and white flags provided the background information of the company president, suggesting high and low risk of fraudulent reporting respectively. The outcome information was manipulated as either a positive or a negative outcome condition. The results revealed that the auditors evaluated the performance of the audit engagement partner's decision more favourably than the judges. These results indicated an expectation gap between the expectation and the actual perception of the judges on the audit profession in terms of the auditor's role and responsibilities. Also, the subjects as a whole exhibited the hindsight bias in which subjects who were given

the positive outcome evaluated the performance of the audit engagement partner's decision more favourably than those who were given the negative outcome. Nonetheless, the inclusion of flag cues did not affect the judgments of the subjects.

The hindsight bias was also supported in two management accounting studies (Brown and Solomon, 1987; Lipe, 1993). Brown and Solomon (1987) asked 96 business students to evaluate a capital budgeting committee's decision to fund a particular proposal. Subjects were randomly assigned to one of the four outcome groups: no outcome reported (foresight), project failure due to a change in the federal copyright law (negative hindsight with evaluatee less responsible for the outcome), project failure due to economic factors (negative hindsight with evaluatee more responsible for the outcome), and project success (positive hindsight). The results indicated the existence of the hindsight bias among the subjects. The evaluation of the "negative hindsight with evaluatee more responsible for the outcome" group and the "positive hindsight" group was significantly different from that of the "foresight" group. However, the evaluation of the "negative hindsight with evaluatee less responsible for the outcome" group was not significantly different from that of the "foresight" group.

In another management accounting task, Lipe (1993) conducted three experiments by asking both business students and business people to evaluate a subordinate's performance, perceived benefits and the degree of cost or loss in a variance investigation. Subjects were randomly assigned to two outcome groups: the outcome of the investigation was out of control versus in control. It was found that the subordinate's performance was perceived more favourably if the system was found to be out of control than if it was found to be in control. This result also supported the existence of the hindsight bias among the subjects.

Accounting researchers identified a number of factors affecting the degree of the hindsight bias in making accounting decisions. These factors can therefore be used to mitigate the extent of this bias. As documented earlier in this section, Brown and Solomon found that the effect of outcome information on evaluating managerial decisions was significantly smaller when an evaluator had had prior involvement in the decision being evaluated, than when he or she had had no such prior involvement. Similarly, the effect of outcome information on evaluating failed managerial decisions varied in direct relation to the extent to which the reported outcome implied that an evaluatee was responsible for anticipating the outcome.

In summary, most of the accounting studies reviewed in this section provided only weak support for the hindsight bias committed by several types of subjects in a variety of accounting tasks. These subjects included business students, business people, auditors, and judges in a court case involving auditors. Although these studies did not provide the reasons for this difference, the conservatism among auditors could once again be used to account for some of these results.

3.3.9 Accountability

It was recognised that the most important aspect of auditors' judgments is to justify their decisions (Gibbins, 1984; Gibbins and Emby, 1984; Emby and Gibbins, 1988). Messier and Quilliam (1992) reviewed the accounting literature of accountability and proposed that accountability tended to increase the auditors' level of cognitive processing, which might have both positive and negative effects on judgment process and performance. Therefore, the effect of accountability on audit performance attracted most accounting researchers' attention in this area (e.g., Ashton, 1990; 1992; Johnson and Kaplan, 1991; Kennedy, 1993).

Johnson and Kaplan (1991) asked a group of auditors to assess the risk of obsolescence for inventory items. Subjects in the accountable group were told that their judgments would be reviewed and they would be asked to explain their judgments. Subjects in the control group were told that their judgments were anonymous. Judgment performance of the two groups was compared for consensus, consistency, and self-insight. Consensus was defined as an agreement across auditors. Consistency was defined as the proportion of variance captured by a model of the individual's judgments in relation to the corresponding cues. Self-insight was defined as the extent to which auditors were aware of their own judgment process. The results revealed that auditors in the accountable group were found to display higher consensus and self-insight than auditors in the control group. The consistency of their performance between these two groups was, however, not significantly different from each other.

Ashton (1990; 1992) examined the effects of accountability and the use of decision aids on audit judgment performance. Auditors were asked to predict the ratings assigned by Moody's Investors Service to bonds issued by 16 industrial corporations based on three financial ratios and a decision aid that was derived from a linear regression of the actual Moody's ratings on the same ratios. The results suggested that when a decision aid was not available, justification increased mean accuracy and decreased variability among the subjects, relative to the absence of the justification manipulation. When the decision aid was available in addition to the justification manipulation, mean accuracy decreased and variability among the subjects increased, relative to the absence of the justification manipulation (Ashton, 1990). Therefore, the justification requirement promoted greater consensus among auditors.

Kennedy (1993) used a sample consisting of 58 executive M.B.A. students and 171 auditors to examine whether accountability could be used to reduce the order effects in belief updating. It was found that post- and non-accountable M.B.A. students who received evidence in a positive/negative order exhibited a recency effect and judged the likelihood of failure to be greater than those who received the evidence in a negative/positive order. Pre-accountable M.B.A. students and auditors did not exhibit such a recency effect in their likelihood judgments.

In summary, the studies reviewed above lent some comfort to the potential problems associated with the judgment biases committed by auditors. The judgment biases commonly found among students did not seem to be a major problem for auditors in performing audit tasks. The major reason is that the task structure of auditing has incorporated the element of accountability to serve as a defence against the effort-driven judgment biases, such as the order effects in belief revision.

3.3.10 Base-Rate Fallacy

3.3.10.1 Overview

The base-rate fallacy, the focus of the current study, is the individuals' tendency to under-utilise base-rate information in favour of case-specific evidence, rather than integrate the two as prescribed in the normative probability theories (see Section 2.5.12 for more detailed discussion). Accounting studies examining this fallacy were classified broadly into three categories by Smith and Kida (1991): (1) attention to base rates, (2) attention to source reliability, and (3) insensitivity to sample size.

3.3.10.2 Attention to Base Rates

A base rate is an important piece of information when auditors or financial statement users are required to make likelihood judgments on the management fraud or the going-concern of a firm. Several accounting studies used both business students and accounting professionals, such as auditors and bank loan officers, as subjects to examine these judgments. On the one hand, accounting researchers attempted to verify the applicability of the findings in previous psychology studies to accounting experts. On the other, accounting researchers designed more realistic business problems to investigate whether the ignorance of base-rate information, found in previous psychology studies, was due to unfamiliar tasks being encountered by novice subjects. These accounting studies are reviewed below.

Swieringa, Gibbins, Larsson and Sweeney (1976) conducted two experiments by asking a group of students to perform highly abstract tasks. Experiment 1A replicated the Kahneman and Tversky's (1973) classical lawyer/engineer study. Subjects were given brief personality sketches that were sampled at random from a group consisting of 70 engineers and 30 lawyers (or 30 engineers and 70 lawyers). Subjects were then asked to assess the probability that each description belonged to a lawyer (or an engineer). The results conformed substantially to the Kahneman and Tversky's findings. The median responses indicated that the subjects focused on base rates only when no individuating information was provided or when they perceived the individuating information as being useless, but they ignored base rates when they perceived the individuating information as being useful. Experiment 1B adopted the Kahneman and Tversky's experiment to describe the internal control system of a company. The results were quite similar to those of Experiment 1A.

Joyce and Biddle (1981b) conducted a series of experiments to investigate whether base-rate information was ignored by auditors in fraud detection tasks. The first

experiment used an adapted version of the medical-diagnosis problem of Hammerton (1973). One hundred and thirty-two auditors were told that a team of accountants and psychologists had developed a procedure to test for management fraud by comparing the personality profile for a key manager to a master profile compiled by clinical psychologists. On the basis of the similarity of the two profiles, the test was said to signal "fraud" or "no fraud". They were then asked to assess the probability that a key manager who received a "fraud" test signal was actually involved in fraudulent activity. The results indicated that auditors did not completely ignore the given base-rate information, but their responses to this information were found to be insufficient. The subsequent experiments conducted by Joyce and Biddle (1981b) only modified the values of base rates and the population size of management descriptions. The results were similar to those of the first experiment.

Holt (1987) extended the results of Joyce and Biddle (1981b) to student subjects and to comparing the judgments of both student and auditor subjects. Holt found that the auditors' judgments in Joyce and Biddle's study were not better than the students' judgments in Holt's experiment on the same task of detecting management fraud. Similarly, the responses of auditors and students to the "taxicab case" were not significantly different. Therefore, the evidence integration was not apparently driven by the auditing context. These results suggested that the actual framing of the case rather than the type of subjects, or the context, determined how the subjects integrated evidence.

The results of previous studies that documented the insufficient attention given to base rates drove accounting researchers to investigate the conditions under which auditors and financial statement users would pay more attention to base-rate information. The variables being investigated included diagnosticity (Johnson, 1983; Hackenbrack, 1992) and neutrality (Hackenbrack, 1992) of case-specific evidence, and causality and specificity of base-rate information (Kida, 1984a).

Johnson (1983) conducted an experiment to investigate the tendency to ignore base rates and to rely exclusively on the representativeness of a company's financial position when making going-concern judgments. Seventy students participated in the experiment. The results suggested that the subjects' probability assessments were sensitive to base-rate information when a corporate financial profile was perceived to be of little value in discriminating between the bankruptcy and nonbankruptcy population stereotypes. Even in those instances where base rates were not ignored, firm-specific financial data continued to dominate subjects' probability assessments to a greater extent than those prescribed by the Bayesian rule. The results of Johnson's experiment supported the notion that the relative perceived relevance of base-rate information and case-specific information determined which type of information would dominate probabilistic judgments. Decreasing the relative relevance of case-specific information increased the relative importance of base-rate information. With similar logic, increasing the relative relevance of base-rate information also increased the relative importance of base-rate information. This suggestion was further examined by Kida (1984a).

Kida (1984a) asked 73 auditor partners and managers to make going-concern judgments and investigated the effects of the causality and specificity of a base rate on their judgments. Causality was manipulated as either causal or non-causal. A non-causal base rate was simply stated that 2% of all firms failed. A causal base rate was stated that 2% of firms with cash flows similar to those of the selected firms failed. Specificity was manipulated as either specific or non-specific. A specific base rate was stated that 2% of all the firms in the same industry as the selected firms' failed. A non-specific base rate was stated as being the same as the non-causal base rate. Subjects were randomly assigned to the four between-subjects groups determined by crossing the two independent variables of causality and specificity as just described. Kida (1984a) found that the subjects reacted to the causal base rate

only. There were no effects of the specific base rate nor the interaction of specificity and causality on their judgments. The result of no effect of the specific base rate was inconsistent with the results of the extant psychology research (Ajzen, 1977; Carroll and Siegler, 1977; Bar-Hillel, 1980a; Tversky and Kahneman, 1982a; Bar-Hillel, 1983). It is still unknown whether the insignificant effect of the specific base rate was due to insufficient manipulation of the variable or due to the effect of having different types of subject. Certainly further studies to resolve this question are needed.

Auditors are required to make judgments on the basis of a broad set of evidence. While some evidence is diagnostic, some other is nondiagnostic. It was found in psychology research that when subjects were given a mixture of diagnostic and nondiagnostic evidence, they made less extreme (more regressive) judgments than those who were given only diagnostic evidence (Nisbett, Zukier and Lemley, 1981; Zukier, 1982; Tetlock and Boettger, 1989). This phenomenon is called the "dilution effect."

Hackenbrack (1992) tested the dilution effect in an audit context. Thirty-nine auditors were asked to assess the change in a company's exposure to fraudulent reporting upon providing both diagnostic evidence and non-diagnostic evidence. Diagnostic evidence was manipulated as evidence pointing to increasing (or decreasing) the company's exposure to fraudulent reporting. Non-diagnostic evidence was not related to the company's exposure to fraudulent reporting, and was manipulated as favourable, unfavourable or neutral evidence. The results suggested that auditors' assessments of the change in a company's exposure to fraudulent reporting were found to be less extreme when nondiagnostic evidence was available than when it was not available. In addition, auditors' assessments were found to be less extreme when nonneutral-nondiagnostic evidence was available than when neutral-nondiagnostic evidence was available.

3.3.10.3 Attention to Source Reliability

Source reliability is an important topic in accounting. Information on financial statements is provided by the management of a firm, which in turn is audited by auditors. The quality of this information therefore depends highly on the reliability of the firm's management and its auditors. Also, auditors rely on the representation made by the management to confirm some important information not being audited. The reliability of this representation should be used by auditors in estimating the risk of issuing a wrong opinion. Moreover, senior auditors rely on the work done by junior auditors to make judgments. The question of how senior auditors evaluate the reliability of the work done by junior auditors is also an interesting and important empirical issue.

Accounting research in source reliability focuses mainly on how auditors evaluate the source reliability of a firm's management, who makes representation and estimation on certain financial information of its firm for the purpose of performing an audit. This type of accounting research was found in the areas of evaluating the collectibility of accounts receivable (Joyce and Biddle, 1981b; Rebele, Heintz and Briden, 1988), evaluating internal control systems (Bamber, 1983), and analytical review (Cohen and Kida, 1989; Anderson, Koonce and Marchant, 1994; Hirst, 1994). In other accounting areas, only one study was found to address the evaluation of the characters of firms' management by lenders in lending decisions (Beaulieu, 1994). These studies are discussed below.

Two of the experiments (Experiments 3A and 3B) conducted by Joyce and Biddle (1981b) were to investigate the effect of source reliability in terms of customer credit-worthiness on auditors' probability assessments on the collectibility of accounts

receivable. These two experiments differed primarily in their experimental designs. One experiment used a between-subjects design, whereas the other used a within-subjects design. Source reliability was manipulated by customer description. In the low source-reliability condition, information was provided by client's credit manager, whereas in the high source-reliability condition, information was provided by an independent credit agency. The results of the two experiments were not conclusive. Source reliability was found to significantly affect auditors' judgments in the within-subjects manipulation, but not in the between-subjects one. Joyce and Biddle (1981b) speculated that these mixed results might be caused by their insufficient manipulation of source reliability in their between-subjects design.

Rebele *et al.* (1988) tested this proposed cause for the conflicting results in Joyce and Biddle's (1981b) study. Auditors were asked to make judgments on the true value of a client's uncollectible receivables. Rebele *et al.* used a stronger manipulation for source reliability by describing the expertise of a client's employee as either high or low. They found that their subjects placed more reliance on the evidence obtained from the high-expertise source than on that obtained from the low-expertise source.

The issue of how source reliability affects audit judgment made at successively higher levels of auditors was addressed by Bamber (1983). Auditors were asked to assume the role of audit managers who were required to evaluate the strength of a client's internal control system, based on the results of sampling procedures conducted by subordinates with different reliability. Source reliability was manipulated as either high or low technical ability of the subordinates. The results strongly indicated that source reliability within an audit firm had a significant impact on audit managers' judgment. In fact, a comparison of the auditors' posterior judgment with the normative probability estimates suggested somewhat excessive discounting for less-than-perfect source reliability. This finding was inconsistent with cascaded inference research that found insufficient discounting for source-reliability information (Schum

and DuCharme, 1971; Schum, DuCharme and DePitts, 1973; Schum, 1980). Although the findings might be due, in part, to the use of a repeated measures design, this design represented a common situation for an audit in practice.

The extent of substantive tests in an audit should be affected by the reliability of an internal control system. All things being equal, the stronger the system, the less the extent of detailed substantive tests required to achieve the same level of confidence of an opinion issued by auditors. To test this premise, Cohen and Kida (1989) asked a group of auditors to determine if the nature and/or the extent of this typical audit plan would require any modifications after viewing the description of the firm's internal control and the analytical review results. They adopted a between-subjects design in which the firm's internal control was manipulated as either strong or weak, and the analytical review results were manipulated as pointing to either an error or no error.

In Cohen and Kida's study, it was found that both the firm's internal control and the analytical review results had significant effects on the auditors' judgments on the number of hours allocated to the subsequent detailed audits. Auditors were found to allocate more hours of audit work to a weak internal control system than to a strong internal control system. Auditors were also found to allocate more hours of audit work when the analytical review results pointed to an error than to no error. Furthermore, consistent with other accounting studies that auditors had a tendency towards conservatism, auditors in this study did not reduce the amount of audit work when the analytical review results signalled no error.

Auditors inevitably rely on the representation provided by the management of a firm to explain any unexpected fluctuation found during an analytical review. Anderson *et al.* (1994) investigated the effects of source competence and the timing of receiving the source-competence information on assessing the likelihood that a client manager's explanation accounted for substantially all the increase in gross margin, and on

recalling case information. Auditors were assigned to one of the four treatment groups determined by crossing two levels of source competence (high or low) and two timings of receiving the source-competence information (before versus after receiving the client manager's explanation). The results indicated that the client manager's explanation was considered by auditors to more likely account for substantially all the increase in gross margin when the source was highly competent, than when the source was less competent. In addition, auditors recalled more case information when the source was highly competent and the source-competence information was received by the auditors before the manager's explanation was given to them, than when the source was less competent and the source-competence information was received by the auditors after being given the manager's explanation.

Source competence was further investigated by Hirst (1994) in two experiments. The first experiment investigated the effects of source competence and source objectivity on auditors' probability estimation of inventory misstatement. Source competence was manipulated on two levels. The high source competence described the source as a specialist with excellent technical ability, whereas the low source competence described the source as a specialist with below average technical ability. Source objectivity was manipulated as either an independent audit firm or a client's chief financial officer. Certainly, the independent audit firm was a more objective source than the client's chief financial officer. Hirst found that the high competence-high objectivity source's report had greater inferential value to the auditors' judgment than any other reports.

Hirst's second experiment investigated the effects of source objectivity and source verifiability on auditors' probability estimation of inventory misstatement. Source verifiability was manipulated on two levels. The less verifiable report dealt with provision for obsolete inventory, whereas the more verifiable report dealt with inventory pricing and cut-off. Like the results of the first experiment, source

objectivity was found to have a similar effect on the auditors' probability estimation. Source verifiability was, however, found to have no such effect.

The only accounting study examining source reliability not related to auditing was performed by Beaulieu (1994) who examined the effects of a loan applicant's character on lending decisions and risk assessments of the loan. One hundred and thirty bank loan officers were provided with both accounting and character facts which were manipulated as either positive or negative. The results indicated that bank loan officers were more likely to grant loans to applicants with positive accounting and character facts than those with positive accounting facts but negative character facts. When accounting facts were negative, bank loan officers' decisions were not affected by character facts at all. The results for the risk assessments made by bank loan officers were similar to those of the loan granting decisions.

3.3.10.4 Insensitivity to Sample Size

In view of a high cost and practical impossibility of testing all evidence that supports financial statements, auditors are frequently required to rely on sample evidence to assess the characteristics of an audit population. They are regularly called on to determine appropriate sample sizes or to analyse and interpret sample results. Therefore, auditors' insensitivity to sample size could lead to serious mistakes in their judgments. Although this issue is important, only two accounting studies were found to address it. These are described below.

Swieringa *et al.* (1976) conducted a series of experiments to replicate the results of insensitivity to sample size found in previous psychology studies. In two of their experiments, they adopted the "hospital problem" as described by Tversky and Kahneman (1974) and constructed a problem of similar structure but in a business

context. These problems were then presented to a group of students. The results of these two experiments suggested a general failure among their subjects to recognise more variable sample results in smaller samples.

In another set of experiments, Swieringa *et al.* first replicated and presented the "urns problem" described by Kahneman and Tversky to a group of students. They then presented an accounting-oriented problem of similar structure to another group of students. Once again, a large number of subjects were found to be insensitive to sample size. A simple translation from the urns problem to an accounting-oriented problem was, however, found to have a significant effect on the subjects' judgments. Subjects in the accounting-oriented problem were found to choose the correct answers more often than those in the more abstract urns problem. This indicated the situational sensitivity of the results and suggested that the problem of insensitivity to sample size would be mitigated when auditors were dealing with familiar audit tasks. This suggestion was investigated by Uecker and Kinney (1977).

Uecker and Kinney presented an audit situation involving a compliance test to 112 auditors, and provided in each problem a finite population, a sample size, the number of errors, and a sample error rate. Subjects were asked to select the sample results that provided better evidence with a population error rate of 5% or less. Overall, 69% of the responses were correct, which was much higher than those reported by the other studies in psychology using students as subjects. These results suggested that many auditors were insensitive to sample size, but their sensitivity was much higher than students in other psychology research.

3.3.10.5 Summary for Accounting Research on the Base-Rate Fallacy

Similar to previous psychology studies, business students, auditors and lenders were found to commit the base-rate fallacy. Fortunately, when they were asked to make judgments in more practical accounting tasks, the extent of this fallacy was found to be much less serious than that in psychology studies. However, only few accounting studies were found to investigate this fallacy, especially in those tasks other than auditing. Certainly, these results are not conclusive and this research area warrants additional research efforts.

3.3.11 Overconfidence Effect

Auditors and financial statement users are frequently required to make probabilistic judgments for future uncertain events. For example, auditors need to issue an audit opinion, which is a kind of probability assessment, based on the strength of evidence collected and examined. As documented previously in Section 2.5.13 of Chapter II, the extant literature of probabilistic judgments in psychology suggested that people tend to be overconfident. Several accounting studies can be found to investigate whether auditors were also overconfident and what the major factors affecting the appropriateness of auditors' confidence were (Tomassini *et al.*, 1982; Solomon *et al.*, 1985; Moeckel and Plumlee, 1989; Dilla *et al.*, 1991; Ismail and Simnett, 1991; Pincus, 1991; Mladenovic and Simnett, 1994; Simnett, 1994). These studies are reviewed below.

3.3.11.1 Appropriateness of Auditors' Confidence

Tomassini *et al.* (1982) investigated whether auditors were well-calibrated when making judgments in practical audit settings. Fifty-eight auditors were asked to assess prior probability distributions in testing a client's account balances. Subjects' probability assessments were elicited through the cumulative distribution function fractiles method in which subjects were asked to specify the estimated values for each of the fractiles of 0.50, 0.25, 0.75, 0.1, 0.9, 0.01, and 0.99. The assessments were then analysed by the interquarter index and the surprise index. The interquarter index was the percentage of observations for which the actual outcome had fallen within the interquartile range. The surprise index was the percentage of true values falling outside the extreme fractiles. The results showed that auditors were found to be less overconfident than those subjects in previous psychology studies. In fact, the auditors were found to exhibit a tendency towards underconfidence. The authors attributed these results to the inherent motivation of the auditors to be successful in the task, the nature of an audit process directing auditors' attention to their legal liability, and the training that auditors received. All these factors made auditors particularly cautious and risk-averse in making probabilistic judgments.

The appropriateness of auditors' confidence was further investigated in a task of going-concern judgments. Dilla *et al.* (1991) provided 36 auditors with six financial ratios and a base rate for bankruptcy. Subjects were asked to assess bankruptcy probability for each firm. Similar to the findings noted by Tomassini *et al.* (1982) and Solomon *et al.* (1985), the results indicated that the aggregate auditor calibration curve showed a slight, but insignificant, underconfidence. The results for the individual types of predictions, however, revealed a highly significant underconfidence for non-bankruptcy predictions and a moderately significant tendency towards overconfidence for bankruptcy predictions. Also, the performance of individual auditors suggested that the majority of subjects were underconfident.

3.3.11.2 Factors Affecting the Appropriateness of Auditors' Confidence

In view of the finding of Tomassini *et al.* (1982) that auditors were less susceptible to the overconfidence effect than novice subjects reported in previous psychology studies, Solomon *et al.* (1985) investigated why this was so. They proposed that task context was the major reason to account for the differences. The results showed that auditors were overconfident in answering some general-knowledge questions, but were predominantly underconfident in performing a more practical audit task. Therefore, these results supported the explanations provided by Tomassini *et al.* for the underconfidence effect among auditors.

However, there were two major shortcomings in Solomon *et al.*'s study. First, the predictability of two tasks had not been taken into consideration. Therefore, the extent of overconfidence in Solomon *et al.*'s study might not be driven by different task contexts. Instead, different predictability between the two tasks could be a major reason to account for their results. Second, Solomon *et al.* used only auditors as the subjects of their study. Whether auditors' risk attitude towards audit tasks and that towards answering general-knowledge questions are the same remains unanswered.

The above two issues were addressed by Mladenovic and Simnett (1994). They examined two competing explanations of task predictability and the contextual effect for divergence among the studies in psychology and auditing. Task predictability is the extent to which the outcome of a task can be predicted by the given information. The task predictability explanation suggested that as the task became more predictable, the degree of overconfidence decreased (Lichtenstein *et al.*, 1982). The contextual effect explanation suggested that auditors were sensitive to the

asymmetric risk consequences associated with wrong judgments. To investigate which of these two competing explanations was more plausible, a group of auditors and a group of students were asked to answer both auditing and general-knowledge questions across two levels of task predictability. The results revealed that both task predictability and the contextual effect were found to have significant effects on the degree of overconfidence when these factors were examined separately. When task predictability was controlled for, however, most of the contextual effect disappeared. They concluded therefore that difference between task predictability among various studies could be used to reconcile the conflicting findings of the audit and psychology calibration literature.

Most calibration studies to date treated decision-making as a static process in which decision makers rendered a decision on the basis of whatever information given to them. Pincus (1991), however, questioned about whether the use of a static process for the research of audit judgment confidence is appropriate in view of the fact that in most of the audit tasks, auditors are allowed to select the amount and type of information they examine before reaching a decision. Pincus suggested two alternative views on audit judgment confidence: an output variable view and a process variable view. When judgment confidence is viewed as an output variable, an auditor chooses the best subset of evidence from the potential evidence available, given certain resource and cost constraints. On the basis of this evidence set, the auditor reaches a decision to which a degree of confidence is attached. The degree of confidence indicates the auditor's subjective probability that the decision reached is correct. Therefore, confidence is the post-decision self-assessment of the correctness of the decision made. In this case, there is an ideal relationship between confidence and accuracy, and confidence should be higher for correct decisions and lower for incorrect decision.

When confidence is viewed as a process variable, audit judgment confidence serves as an indicator of when a decision point is reached. Once an auditor has accumulated sufficient evidence to pass a desired confidence threshold for a particular decision alternative, the auditor stops gathering evidence and that decision alternative is chosen. Therefore, judges have a pre-decision confidence threshold for determining when to stop gathering evidence and make a decision. This threshold will be set at a level to maximise the net benefit (or minimise the net cost). Under this view, there is no expected relationship between confidence and accuracy in audit judgment tasks, nor any difference in confidence for making correct and incorrect decisions.

One hundred and twenty-five auditors were asked to decide if the year-end inventory account of a client was fairly presented or not. Subjects controlled their own information selection and decided when they were ready to make their decision. The results indicated that judgment confidence and accuracy were not significantly correlated, which was consistent with confidence being viewed as a process variable, rather than an output variable.

Simnett (1994) examined the effect of information selection and task predictability on auditors' confidence and the appropriateness of their confidence. Eighty-four audit seniors were allocated to one of the four treatment groups crossed by information selection and task predictability. Information selection was manipulated on two levels. On the one level, subjects were asked to identify four ratios out of the ten provided that they would like to be supplied with in order to distinguish between bankruptcy and non-bankruptcy firms. On the other level of information selection, subjects were provided with the four ratios selected by a discriminant analysis model as the most useful for identifying firms being in bankruptcy. Task predictability was manipulated as providing the subjects with financial ratios of either one year or two years prior to the events (i.e., bankruptcy or non-bankruptcy). The results indicated no significant effect on judgment confidence arising from information selection.

Contrary to the Pincus's findings of no significant relationship between auditors' decision accuracy and decision confidence, Simnett found his subjects' judgment confidence varied positively with the change in task predictability. Specifically, a higher level of auditors' judgment confidence was associated with a more predictable task. However, the changes in auditors' judgment confidence did not fully reflect changes in their decision accuracy. As a result, auditors tended to have underconfidence, with more pronounced underconfidence on the more predictable task.

Since auditors are required to evaluate large quantities of information in order to comply with audit standards, they frequently rely on their memory to make judgments. Moeckel and Plumlee (1989) investigated the confidence and calibration of relying on memory among auditors, rather than referring to working papers or source documentation. They asked a group of auditors to review a set of hypothetical audit work. They classified audit evidence into three types of items: explicit items (i.e., items directly drawn from working papers), new items (i.e., items not mentioned in the working papers), and inferential items (i.e., items that could be inferred from the working papers). The results revealed that the subjects were found to be well-calibrated for explicit items, underconfident for new items, and underconfident at low levels of confidence and overconfident at high levels of confidence for inferential items.

Since in practice most audits are conducted in teams or groups, the effect of audit groups on judgment confidence is an important issue influencing the effectiveness of audits. This issue was investigated by Ismail and Simnett (1991) in a task in which a group of auditors were asked to estimate an interval of an expected dollar error in the total inventory of a firm. Two forms of audit groups were investigated: an interacting group composed of two audit seniors, and a hierarchical review group consisting of an audit senior and an audit manager. The results were consistent with

the findings of psychology and accounting research in that group interaction was found to increase judgment confidence. Experience was found to moderate this effect with more experience for lower confidence. The results also indicated that when compared with individual judgments, confidence was found to be higher in the interacting group but similar to that in the hierarchical review group. Furthermore, the hierarchical review group was found to be less confident than the interacting group.

In addition to comparing the confidence among individual auditors and the two audit groups, Ismail and Simnett (1991) conducted an additional analysis for the appropriateness of auditors' confidence. The results revealed that individuals and both types of audit groups were found to be significantly overconfident. The hierarchical review group, however, displayed less overconfidence than individual auditors and the interacting group. This finding supported the suggestion of Tomassini *et al.* that an audit review process might reduce judgment biases among individual auditors.

In summary, although only a small number of studies were conducted to investigate the appropriateness of auditors' confidence in some audit tasks, the results were fairly consistent and indicated that auditors were less overconfident than novice subjects examined in the majority of psychology studies. The major reason to account for this difference, as suggested by accounting researchers, was that the auditing environment has imposed a high cost upon auditors if they are overconfident. This environment makes auditors more cautious and more conservative in making audit judgments.

3.4 Behavioural Decision Research in Financial Distress Prediction

3.4.1 Overview

Financial distress prediction (also known as firm failure prediction or bankruptcy prediction in some studies) is a major task of bank loan officers when they evaluate the financial soundness of potential and existing borrowers. Although bank loan officers are required to examine a large amount of evidence on various aspects related to the financial viability of borrowers, financial statement information remains the focus of the extant accounting research in this area.

This section provides a detailed review of the literature related to the decision behaviour of bank loan officers when predicting the probabilities of firms being in financial distress. Although the Heuristics-and-Biases framework is important for this line of research, some of the studies in this research area have adopted other research frameworks in BDT. In order to provide a comprehensive picture on this research area and assist in developing the research model of the current study, all these previous studies are discussed in this section.

Three major issues were addressed by researchers in this area. The first issue is the prediction performance of individual bank loan officers. The second issue deals with the major factors affecting the prediction performance of bank loan officers. The final issue is concerned with comparing the prediction performance of bank loan officers individually and in groups. These issues are described below.

3.4.2 Prediction Performance

Two major measures of prediction performance were used by researchers in this area: prediction accuracy and appropriateness of confidence. The early research focused mainly on prediction accuracy which is the proportion of correct judgments. The recent research began to recognise appropriateness of confidence as a finer measure of bank loan officers' prediction performance in this prediction task (see Section 1.1 of Chapter I for a discussion of how to measure appropriateness of confidence).

3.4.2.1 Prediction Accuracy

Several studies can be found to examine the prediction performance of bank loan officers when predicting firms being in financial distress by using prediction accuracy. Libby (1975b) asked a group of professional lending officers to identify firms being in financial distress from a sample of 60 firms of which 30 firms were healthy and the others were in financial distress. The result indicated that the overall prediction accuracy of bank loan officers was around 74%, which was far better than a random guess. A study of Australian bank loan officers' prediction of firms being in financial distress by Zimmer (1980) revealed a similar result. The overall prediction accuracy of the subjects in Zimmer's study was around 77%, which was comparable to Libby's result.

In a questionnaire study conducted by Casey (1980b), a less clear picture was shown. Casey (1980b) asked 46 bank loan officers to predict whether the given firms would be in financial distress. The results showed that the overall prediction accuracy of the subjects was around 57%. Although this accuracy rate was still higher than a random guess, it was much lower than the results indicated in the other two accounting studies as described above.

3.4.2.2 Appropriateness of Confidence

As discussed previously in Section 2.5.13 of Chapter II, overconfidence results from a higher judges' confidence rating than the actual probability. Several accounting studies examined the relationship between the bank loan officers' confidence and their accuracy. The results of these studies were mixed. While Libby (1975b) and Zimmer (1980) did not find any significant relationship, Casey (1983) did find a significant relationship between these two variables. So far, little theory has been put forward to specify this relationship.

Although the appropriateness of bank loan officers' confidence is a finer measure of their prediction performance, only two accounting studies were found to use this measure. As mentioned earlier in this section, Casey and Selling (1986) asked a group of students to predict whether the given firms were in financial distress. The results revealed that their subjects were overall overconfident. Similarly, Selling (1993) also investigated the appropriateness of confidence for a group of students when predicting firms being in financial distress. The results of this investigation also indicated that the subjects were overconfident. However, since both studies used students as the subjects, their results should be interpreted with caution. Further studies using real subjects are warranted. The current study has taken up this research opportunity and used real bank loan officers to investigate their judgment performance on a task of their expertise.

3.4.3 Factors Affecting Prediction Performance

3.4.3.1 Overview

As mentioned earlier in Section 3.4.2.1, the early research on the decision behaviour of bank loan officers revealed that their accuracy of predicting firms being in financial distress was in general significantly better than a random guess (Libby, 1975b; Zimmer, 1980; Casey, 1980b). Later research in this area focused on identifying the major factors affecting their prediction accuracy. Regarding the other measure of prediction performance, only two studies can be found to examine the major factors affecting the appropriateness of bank loan officers' confidence. Previous studies examining these factors are reviewed below.

3.4.3.2 Information Load

Financial ratios are recognised as being useful for predicting firms being in financial distress. Bank loan officers who are provided with more financial ratios are therefore expected to be more accurate than those who have fewer ratios. However, since human beings are recognised to have only a limited human information processing capacity (Simon, 1955; Miller, 1956; Simon and Newell, 1971), providing more financial ratios does not necessarily lead bank loan officers to have more accurate predictions. Schroder, Driver and Streufert (1967) developed a model that identifies a peak in human cognitive performance as information load increases, where performance deteriorates as information load further increases beyond that point. This model therefore suggests that each individual has a ceiling of information processing capability upon which the individual's performance cannot be further improved. This ceiling, however, varies from person to person. Only one study was

found to address the effect of information load on bank loan officers' prediction performance.

Casey (1980a) asked 122 bank loan officers to predict firms being in financial distress. Subjects were randomly assigned to one of the three treatment groups with different degrees of information load. In the low-load group, subjects were given six ratios for each firm. In the median-load group, subjects were given the same six ratios together with the firm's income statement and balance sheet, but without the notes to accounts. In the high-load group, subjects were given the same information as given to those subjects in the median-loan group as well as the notes to accounts.

The results indicated that the prediction accuracy of the median-load group was better than the other two groups. The results also showed that the time spent by the subjects in the median-load group was significantly less than the time spent by those in the high-load group, but not significantly different from that spent by those in the low-load group. Finally, the prediction accuracy for all bank loan officers was found to be not correlated with the time spent on completing the tasks. Therefore, these findings were in line with the model proposed by Schroder *et al.* (1967).

3.4.3.3 Information Cue Choice Versus Weighing of Cues

In discussing a real-life decision situation, Einhorn (1976) suggested that when forming judgments, judges more actively searched for information and consolidated the information acquired than researchers in BDT had previously assumed. To test this premise, Abdel-khalik and El-Sheshai (1980) asked 28 bank loan officers to predict firms being in financial distress, by allowing them to purchase up to four financial ratios. The results revealed that the choice of information cues was significantly more important than the weights assigned to the selected cues in

determining the prediction accuracy of bank loan officers. These results were also consistent with the suggestion by some researchers in the Lens Model framework of BDT (see Section 2.4 of Chapter II for more detailed discussion) that the effectiveness of a linear model used for predicting human decision behaviour depended largely on identifying and including the right cues in the model (Dawes and Corrigan, 1974). However, the subjects in Abdel-khalik and El-Sheshai's study were found to make a suboptimal choice of the cues.

3.4.3.4 Base-Rate Information

In view of only few firms in the population being in financial distress, base-rate information on financial distress may have a significant effect on the prediction performance of bank loan officers. Accounting studies that investigated the relationships between the prediction performance of bank loan officers and base-rate information addressed two major issues: (1) whether the provision of base-rate information would promote better prediction performance; and (2) if base-rate information was provided, whether the value of a base rate could affect prediction performance. Several accounting studies were found to address these issues (e.g., Abdel-khalik and El-Sheshai, 1980; Casey, 1983; Houghton, 1984; Breda and Ferris, 1992) and these studies are discussed below.

Abdel-khalik and El-Sheshai (1980) did not provide base-rate information to their subjects in the first part of personal interviews. In the second part of the replication, a base rate of 50% was provided to the subjects. The results showed that provision of base-rate information was not found to improve the prediction accuracy of bank loan officers.

Similarly, Casey (1983) investigated the difference in prediction accuracy of identifying firms being in financial distress between two groups of bank loan officers. Bank loan officers in the one group were given only financial data, whereas those in the other group were given both the same financial data and a base rate of 30%. The results also indicated no difference in the prediction accuracy between the two groups.

Houghton (1984) tested the effects of specification of base-rate information and the period of financial data prior to financial distress on bank loan officers' prediction accuracy. He found that specification of base-rate information interacted with the period of financial data prior to financial distress to affect the prediction accuracy of the subjects. Those subjects who were given a base rate of 50% together with the most recent financial data prior to financial distress were found to be the most accurate.

Casey and Selling (1986) examined the prediction accuracy for a group of graduate students when predicting firms being in financial distress. Subjects were assigned to six treatment groups determined by crossing two levels of task predictability and three levels of base rates. The levels of base rates were manipulated as non-specification, 50% and 35%. The results also showed no difference in the prediction accuracy among the subjects given the different base rates.

Breda and Ferris (1992) investigated the prediction accuracy of a group of bank loan officers by field experiments. Three independent variables were tested. Availability of base-rate information was manipulated as either given or not given. The value of base rates was manipulated as either 25% or 50%. The order of presenting the base rates was manipulated as either 50%/25% (i.e., a base rate of 50% was given first, then followed by a base rate of 25%) or 25%/50%. The results suggested that the prediction accuracy of bank loan officers was neither affected by whether base-rate

information was provided, nor the order of presenting base-rate information. The value of base rates, however, was found to affect the subjects' performance. Subjects who were given a base rate of 25% were found to have a higher prediction accuracy than those who were given a base rate of 50%.

The effect of the value of base rates on the prediction accuracy of bank loan officers was also examined by Houghton and Sengupta (1984). Subjects in the one group were given a 33% base rate, whereas subjects in the other group were given a base rate of 50%. Contradictory to the results of Breda and Ferris, Houghton and Sengupta reported no significant difference in the prediction accuracy between the two groups.

In summary, the results of the first issue about whether provision of base-rate information would improve the prediction performance of bank loan officers were fairly consistent. Four out of the five studies being reviewed indicated that provision of base-rate information did not affect the prediction accuracy of bank loan officers. The results of Houghton (1984), however, suggested that provision of base-rate information interacted with the period of financial data prior to financial distress to affect prediction accuracy.

The results of the second issue about whether the value of base rates could affect the prediction accuracy of bank loan officers were mixed. While Breda and Ferris (1992) revealed that provision of an extreme base rate promoted higher prediction accuracy, Houghton and Sengupta (1984), and Casey and Selling (1986) did not show any difference in the prediction accuracy between the subjects who were given an extreme base rate and those who were provided with a base rate of 50%. It is possible that some important factors affecting bank loan officers' prediction accuracy have been neglected in those studies. One such possible factor is task predictability which is discussed in the next section.

3.4.3.5 Task Predictability

The effect of task predictability on the prediction performance of bank loan officers was examined by two accounting studies. Casey and Selling (1986) randomly assigned a group of graduate students to six between-subjects groups determined by crossing two independent variables. Task predictability was manipulated on two levels. Thirty firms were identified by a procedure in such a way that the difference in classification accuracy between using the financial data of one year prior to bankruptcy and that of two years prior to bankruptcy was maximised. All the sample firms were accurately classified using the financial data of one year prior to bankruptcy, and this set of data was defined as being of high task predictability. Only around half of the same group of firms were, however, correctly classified by using the financial data of two years prior to bankruptcy. This set of data was therefore defined as being of low task predictability.

The results indicated that the overall prediction accuracy was significantly affected by task predictability. Subjects in the high task-predictability group were found to have significantly higher prediction accuracy and less overconfidence than those in the low task-predictability group. The effect of task predictability on prediction accuracy and the extent of overconfidence was further supported by Selling (1993) in a similar experiment with the same type of student subjects. In addition, Selling revealed that subjects in the high task-predictability group were found to be less overconfident as more financial data was given, whereas those in the low task-predictability group were not affected by the amount of financial data provided.

3.4.3.6 Reward Structure

In general, almost all the accounting researchers who examined the decision behaviour of bank loan officers when predicting firms being in financial distress did not take reward structure into account in designing their research. Houghton and Robinson (1989), however, suspected that reward structure might have a significant effect on the prediction accuracy of bank loan officers. Forty-four bank loan officers were randomly assigned to two reward-structure groups. Subjects in the "avoid default reward structure" group were highly penalised by their misclassification of distressed firms as being healthy firms. On the contrary, subjects in the "implicit reward structure typical of previous studies" group were not penalised by this misclassification.

The results revealed that the overall prediction accuracy of the two groups was found to be not significantly different from each other. However, when the overall prediction accuracy was broken down into the distressed- and healthy-firms prediction accuracy, the prediction accuracy for distressed firms of the "avoid default reward structure" group was found to be higher than that of the other group. Conversely, the prediction accuracy for healthy firms of the "avoid default reward structure" group was found to be significantly lower than that of the other group.

3.4.3.7 Individual Differences

The effects of some individual difference factors on the prediction performance of bank loan officers when predicting firms being in financial distress were examined in several accounting studies. These factors included the time spent on the task (Casey, 1980b; Zimmer, 1980), qualification (Zimmer, 1980; Houghton and Sengupta, 1984), experience (Zimmer, 1980; Houghton and Sengupta, 1984) and age (Houghton and

Sengupta, 1984). The results showed that all these factors were found to have no significant effect on prediction accuracy.

The type of subjects was also investigated by two studies. For example, Zimmer (1980) compared the prediction accuracy of bank loan officers with that of students. The results also suggested no significant difference in the prediction accuracy of individual subjects, total confidence, the overall accuracy and the time spent on completing this task.

Holt and Morrow (1992) compared the risk assessments between bank loan officers and auditors in two dimensions. Experience of the subjects was manipulated on four levels. Type of cases was manipulated as either financially strong prospective cases or financially weak prospective cases. The results indicated that auditors' risk assessment was similar to that of bank loan officers. These results also suggested that auditors' risk assessment was closer to the Bayesian rule as their experience increased, whereas bank loan officers' did not follow this relation. Finally, it was found that the financial strength of the client case had little effect on the auditors' use of the Bayesian rule for evidence integration, whereas bank loan officers deviated from the Bayesian rule in evaluating financially weak clients.

3.4.4 Group Judgment Accuracy

In reality, lending decisions are usually made by a group of bank loan officers or a committee, rather than by individual bank loan officers. However, only one study was found to examine the group judgments of bank loan officers. Libby, Trotman and Zimmer (1987) asked a group of bank loan officers to predict firms being in financial distress both individually and in groups. The prediction accuracy of these bank loan officers was evaluated by averaging the predictions of all the individual

bank loan officers, by a composite group (that was a simple average of all the predictions of the individual bank loan officers in a group), and by an interacting group (group members were allowed to discuss and agree on the best answers).

The results indicated that the prediction accuracy of both the composite group and the interacting group was better than that of simply averaging the predictions of all individual bank loan officers, but the prediction accuracy of the composite group and the interacting group did not differ significantly. The results also showed that as the ranking of the most influential member or the variation in individual performance increased, the difference between the prediction accuracy of the interacting and composite groups also increased.

3.4.5 Section Summary

This section summarises the findings on the decision behaviour of bank loan officers when predicting firms being in financial distress. Three major findings were noted. First, financial information was found to be useful for bank loan officers when predicting firms being in financial distress. The prediction accuracy of bank loan officers using financial information was found to be significantly higher than a random guess. When appropriateness of confidence was used to measure the subjects' prediction performance, they were found to be overconfident. However, the two studies (Casey and Selling, 1986; Selling, 1993) that investigated appropriateness of confidence used students as the surrogates for bank loan officers. Therefore, the generalisation of their conclusions to real subjects might be difficult.

Second, several factors were identified to affect the prediction performance of bank loan officers. The results indicated that information load, information cue choice, provision of base-rate information, and task predictability were found to affect the

prediction accuracy of bank loan officers. In addition, task predictability was found to have a significant effect on appropriateness of confidence. Specifically, subjects who were given a task of high predictability were found to have less overconfidence than those who were given a task of low predictability. However, some of these studies used students as subjects, which limited the external validity of their findings. Conversely, individual difference factors, such as the time spent on the task, qualification, experience, age and type of subjects, were found to have no significant effects on prediction accuracy. However, some of these studies used students as subjects which limited the external validity of their findings.

The results of the value of base rates were mixed. While Breda and Ferris (1992) showed that bank loan officers who were given an extreme base rate were found to have a significantly higher prediction accuracy than those who were given a base rate of 50%, Houghton and Sengupta (1984) and Casey and Selling (1986) did not support this relation. Moreover, reward structure was found to affect the prediction accuracy for either distressed firms or healthy firms only, but not the overall prediction accuracy.

Third, the prediction accuracy of both a composite group and an interacting group was found to be better than that of simply averaging the predictions of all individual bank loan officers. In addition, the extent to which the interacting group outperformed the composite group in prediction accuracy was found to directly relate to the ranking of the most influential member or the variation in the performance of individual bank loan officers within the groups.

3.5 Motivation for the Current Study

This chapter and the last have reviewed a substantial body of literature on BDT, BDR in accounting that adopted the Heuristics-and-Biases research framework, and BDR in financial distress prediction. From this literature review, at least four research opportunities related to financial distress prediction by bank loan officers can be identified. These identified research opportunities in turn motivate the conduct of the current study and assist in developing the specific research model to be discussed in Chapter IV.

3.5.1 Research Opportunity 1

The review of literature on the BDR in financial distress prediction in Section 3.4 revealed that although financial distress prediction is one type of probabilistic judgments, and appropriateness of confidence is recognised by psychology researchers in BDT to be a finer measure for the performance of these judgments (Wright *et al.*, 1994), very few studies can be found to use this measure for examining the decision behaviour of bank loan officers. Prediction accuracy remained the predominant measure of prediction performance in almost all the previous studies in this line of research. A similar problem was also noted in psychology, in that research in BDT focused mainly on choices but ignored the confidence of these choices (Sniezek and Buckley, 1993, p.105):

> "Decision-making research and theory has given centre stage to the behaviour of deciding — choosing from a set of alternative courses of action. The decision maker's uncertainty about the relative quality of those alternatives is frequently neglected or viewed merely as a by-product of the decision-making process. Measures of uncertainty — or, conversely, confidence — often appear to be an

afterthought. But the argument can be made that the decision maker's uncertainty about that choice may be as important to decision theory and practice as (the) choice itself."

Two studies (Casey and Selling, 1986; Selling, 1993) were found to use appropriateness of confidence as the measure of prediction performance to investigate human decision behaviour in a lending decision context. The results of both studies showed that their subjects were found to be significantly overconfident. However, both studies used students as surrogates for bank loan officers. As discussed earlier in Section 3.2, the characteristics of decision makers are one major determinant of decision-making performance. In particular, the task knowledge of decision makers was identified as one such characteristic. It is therefore still unknown whether the difference in task knowledge between students and bank loan officers will lead to a different conclusion on bank loan officers' overconfidence. Additional research efforts on using this measure for studying the prediction performance of bank loan officers are warranted.

Therefore, the first research opportunity is to investigate whether bank loan officers are overconfident when predicting firms being in financial distress.

3.5.2 Research Opportunity 2

Since task predictability is the only factor that was consistently supported by previous accounting studies as affecting the appropriateness of subjects' confidence when predicting firms being in financial distress, the general understanding of the other major factors that could affect the appropriateness of bank loan officers' confidence is rather limited. Additional efforts on identifying these factors are much needed for developing better theories in this line of research. This point of view was also shared

by psychology researchers who highlighted the need of better understanding the major factors that could affect the performance of general probabilistic judgments. For instance, Wright *et al.*, (1994, p.7) contended that:

> "Plainly, experts can be expected to outperform novices in many judgment tasks, although even this brief review has shown that experts will not always be immune to the biases observed in simple laboratory experiments with naive subjects. *Identifying the precise factors which contribute to optimal judgmental performance remains a task for future research.*" (emphasis added)

In order to identify the major factors affecting the appropriateness of bank loan officers' confidence, it is necessary to refer to the literature of BDR in accounting and BDT. As mentioned earlier, there is only few firms being in financial distress. Therefore, base-rate information is an important piece of information for assisting bank loan officers to make better judgments. A meta-analysis for a number of accounting studies that examined the prediction of financial distress by bank loan officers also expressed a similar view on the importance of base-rate information in this task (Hite, 1987). Hite suggested that base-rate information could be a significant variable for explaining the differences in prediction performance of bank loan officers among the various accounting studies reviewed. In fact, the relevance of base-rate information is one of the key independent variables of the current study.

In investigating the auditors' going-concern judgments in an audit engagement, Kida (1984a) revealed that the relevance of base-rate information affected auditors' judgments. This result was also in line with the extant psychology literature in BDT showing that the more relevant base-rate information was more likely to be used than the less relevant (Ajzen, 1977; Carroll and Siegler, 1977; Tversky and Kahneman, 1982a; Bar-Hillel, 1980a; 1983). However, Kida (1984a) did not address any effect of the relevance of base-rate information on the auditors' judgment performance, such

as the appropriateness of their confidence. Since the task of predicting firms being in financial distress by bank loan officers is very similar to that of auditors' going-concern judgments, it is expected that the relevance of base-rate information may also affect bank loan officers' judgment performance. However, the relationships between the relevance of base-rate information and bank loan officers' judgment or their judgment performance have not been investigated by previous accounting studies in BDR in financial distress prediction.

The second research opportunity is, therefore, to investigate whether the relevance of base-rate information is a major factor affecting the appropriateness of bank loan officers' confidence when they predict firms being in financial distress.

3.5.3 Research Opportunity 3

Closely related to base-rate information is case-specific evidence that has been considered to be affecting the judges' use of base-rate information. In investigating how a group of students used the representativeness heuristic in making going-concern judgments, Johnson (1983) found that base-rate information was more likely to be used when case-specific evidence was perceived as less representative and thus less informative. However, Johnson did not address the subjects' judgment performance, such as the appropriateness of their confidence. In view of the similarity of these two tasks, it is expected that the perceived informativeness of case-specific evidence may also be a major factor affecting the bank loan officers' judgment performance. Nevertheless, this factor was not investigated by previous studies in either BDT or BDR in financial distress prediction.

Accordingly, the third research opportunity is to investigate whether the perceived informativeness of case-specific evidence is a major factor affecting the

appropriateness of bank loan officers' confidence when predicting firms being in financial distress. Due to the newness of this variable in the literature and its inherent limitation in the measurement approach, this independent variable was only treated as of exploratory and supplementary nature in the current study.

3.5.4 Research Opportunity 4

As discussed earlier in Section 3.2, the characteristics of decision makers are an important determinant of their decision-making performance. One such characteristic is the motivation of decision makers, which determines the extent of their effort expended on a task. Research in BDT also found that judges' efforts affected their performance (Mayseless and Kruglanski, 1987; Paese and Sniezek, 1991). The need for cognition (NC) trait of judges represents their tendency to expend cognitive effort. This trait was suggested to affect the extent of the base-rate fallacy (Ahlering and Parker, 1989). However, the effects of the NC trait of bank loan officers on the extent of the base-rate fallacy or their prediction performance have not been investigated by previous studies in accounting, nor in psychology.

Thus, the fourth research opportunity is to explore whether the NC trait of bank loan officers is a major factor affecting the appropriateness of their confidence when predicting firms being in financial distress.

These four research opportunities can be summarised in the two related research problems of the current study as presented previously in Section 1.2 of Chapter I: (1) Do bank loan officers tend to have appropriate confidence when predicting the probabilities of firms being in financial distress? and (2) What are the effects of some selected major factors on the appropriateness of bank loan officers' confidence when predicting the probabilities of firms being in financial distress? The first research

opportunity is equivalent to the first research problem, and the three remaining research opportunities are incorporated into the second research problem.

3.6 Chapter Summary

This chapter extended the literature review on behavioural decision theory (BDT) discussed in Chapter II to behavioural decision research (BDR) in accounting, the immediate discipline of the current study. It was found that some of the theories proposed by psychology researchers in the literature of BDT have been well adopted in BDR in accounting.

Since bank loan officers may be susceptible to using various heuristics and committing a variety of biases when predicting firms being in financial distress, studies of BDR in accounting that adopted the Heuristics-and-Biases framework were reviewed. The extant literature in this area examined mainly the judgments of auditors. The general findings from this review were that auditors were also susceptible to various heuristics and biases, but their conservative tendency led them to commit these biases to a much less extent than the student subjects in previous psychology research. These results lend some comfort to the audit profession in view of the legal liability in an audit environment.

This chapter also reviewed the literature of the decision behaviour of bank loan officers when predicting firms being in financial distress. Three major findings were noted in this line of research. First, prediction accuracy was mainly used to examine the prediction performance of bank loan officers in most of the previous studies. The results of these studies indicated that the prediction accuracy of bank loan officers was found to be significantly higher than a random guess. Two studies did adopt appropriateness of confidence as a measure of their subjects' prediction performance,

and indicated that the subjects tended to have overconfidence. However, these two studies used students as the surrogates for bank loan officers to investigate the issue. Therefore, the external validity of their findings was limited.

Second, some factors were found to affect the prediction accuracy of bank loan officers. These factors included information load, information cue choice, provision of base-rate information, and task predictability. Task predictability was also found to affect the extent of overconfidence among subjects, but once again, students were used as the surrogates for bank loan officers. Third, group judgments were identified as a potential means of improving the prediction performance of bank loan officers. The prediction accuracy of both a composite group and an interacting group was found to be better than that of simply averaging the predictions of all individual bank loan officers.

This chapter and the last provided a detailed review on the literature related to this thesis. From this literature review, four research opportunities were identified. These research opportunities were summarised by the two research problems as presented in Section 1.2 of Chapter I. On this foundation, the next chapter will discuss the research model and the specific research hypotheses developed.

CHAPTER IV

RESEARCH MODEL AND HYPOTHESES

4.1 Introduction

The preceding two chapters reviewed the literature of behavioural decision theory (BDT) and behavioural decision research (BDR) in accounting, which are considered to be the parent and immediate disciplines of the current study respectively. The aim of this chapter is to develop the research model and hypotheses for the current study on the basis of the four research opportunities identified from the literature review. This chapter is organised into two major sections. Section 4.2 develops the research model delineating all the hypothesised relationships among the variables of interest. Section 4.3 then proposes five research hypotheses for testing the specific relationships among the various variables as depicted in the research model, and discusses the theoretical support for each of these hypotheses. Finally, Section 4.4 provides a summary of the chapter.

4.2 Research Model

As discussed earlier in Section 3.5 of Chapter III, four research opportunities relating to the decision behaviour of bank loan officers when predicting the probabilities of firms being in financial distress were identified from the literature review on BDT, BDR in accounting that adopted the Heuristics-and-Biases research framework, and BDR in financial distress predictions. This section attempts to integrate all these closely related research opportunities into the study's research model with two research objectives in mind. The first research objective is to investigate whether bank loan officers are overconfident when predicting the probabilities of firms being

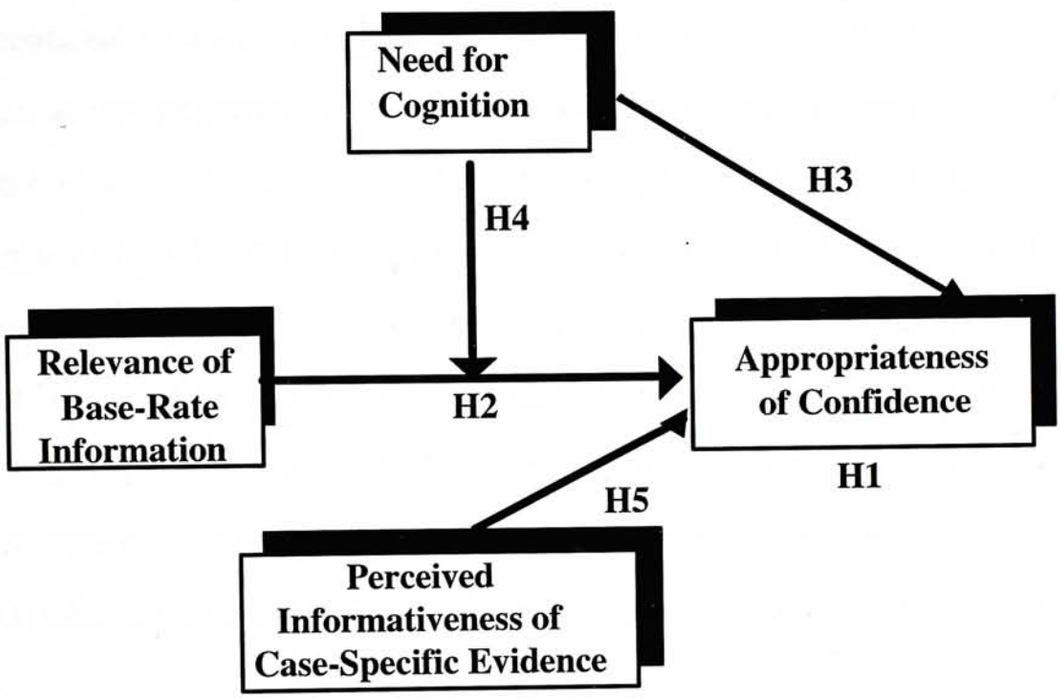
in financial distress. Therefore, the appropriateness of bank loan officers' confidence is the focus of the investigation.

The second research objective is to further investigate some selected major factors affecting the appropriateness of bank loan officers' confidence in this task. Three potential factors were identified from the literature review: the relevance of base-rate information, the need for cognition (NC) trait of bank loan officers, and the perceived informativeness of case-specific evidence. As mentioned previously in Chapters I, II and III, the last factor was only treated as an exploratory and supplementary nature due to its novelty in the accounting literature and the inherent limitations in its measuring approach. Task predictability (or a similar concept called task difficulty) was not studied because it was not related directly to base-rate information which was the focus of the current study. The research model, which was shown in Figure 1.1 of Chapter I and is reproduced here in Figure 4.1 for ease of reference, depicted the relationships among the various variables investigated in the current study.

As shown in the model, the appropriateness of bank loan officers' confidence was the dependent variable. The relevance of base-rate information, the NC trait of bank loan officers, and the perceived informativeness of case-specific evidence were the independent variables that were considered to have certain effects on the appropriateness of bank loan officers' confidence. Since there was no theoretical support for any interaction effects involving the perceived informativeness of case-specific evidence, only the interaction between the relevance of base-rate information and the NC trait of bank loan officers was investigated in the current study.

Five research hypotheses were proposed to test the specific relationships among the variables as depicted in the research model. The development of these hypotheses and their theoretical support are discussed in detail in the next section.

Figure 4.1 Research Model



4.3 Research Hypotheses

4.3.1 Hypothesis 1

The testing of this hypothesis aims to investigate whether bank loan officers tend to have overconfidence when predicting the probabilities of firms being in financial distress. Only two studies were found to address the appropriateness of bank loan officers' confidence in financial distress prediction. Both the studies of Casey and Selling (1986) and Selling (1993) used students as surrogates to examine bank loan

officers' judgments when predicting the probabilities of firms being in financial distress. Their results were similar and found that their subjects were overconfident.

The major shortcoming of these two studies is that both studies used students as surrogates for bank loan officers. It is still not clear whether bank loan officers are overconfident to a similar degree as those student subjects in these two accounting studies in this prediction task. The use of students as surrogates for bank loan officers may not be appropriate because students are not expected to have the expertise of bank loan officers in this task. Also, it was a robust finding in the extant literature in psychology that students were overconfident in answering general-knowledge questions (Lichtenstein and Fischhoff, 1977; Lichtenstein *et al.*, 1982; Griffin and Tversky, 1992). It is therefore still not clear whether the findings of overconfidence in the experiments conducted by Casey and Selling (1986) and Selling (1993) were the results of using student subjects or the results of the task nature.

Some experts, when performing tasks within the scope of their expertise, were found to have relatively appropriate confidence. For example, auditors were found to have fairly appropriate confidence (Tomassini *et al.*, 1982; Solomon *et al.*, 1985; Dilla *et al.*, 1991; Mladenovic and Simnett, 1994; Simnett, 1994) due mainly to their extensive job-related training and the legal liability resulted from their inappropriate confidence. Weather reporters (Murphy and Brown, 1984) and economists (Braun and Yaniv, 1992) were also found to have relatively appropriate confidence for the reasons of having extensive training and timely feedback.

Bank loan officers usually receive extensive training and this background may lead some people to believe that bank loan officers have relatively appropriate confidence. However, bank loan officers are different from the other types of experts. For instance, the feedback given to bank loan officers on their lending decisions is usually more incomplete than that available to the other types of experts. The subsequent

financial conditions of rejected loan applicants are usually not available to bank loan officers for further evaluation (Einhorn and Hogarth, 1978). Even if this information is available, bank loan officers may not give it the same attention as they would to those firms to which loans have been granted (Selling, 1993).

In addition, the decision of whether a loan is granted may have a significant impact on the financial and operational success of a firm. Those who are granted loans will have more chance to pursue their profitable objectives (Einhorn and Hogarth, 1978; Einhorn, 1980; Selling, 1993). Therefore, the results of imbalance of attention and the financial effect of the loans granted on the borrowers' success, may lead bank loan officers to believe that they have made the right judgments in granting the loans to good clients. This inflated impression resulting from directing bank loan officers' attention only to their correct judgments may reinforce their confidence further.

On the basis of the previous findings from studies examining student subjects' judgments in similar tasks and the other reasons given above, the null hypothesis suggests that bank loan officers do not tend to have overconfidence. The alternative hypothesis can be stated as follows:

H1: Bank loan officers tend to have overconfidence when predicting the probabilities of firms being in financial distress.

4.3.2 Hypothesis 2

The testing of this hypothesis attempts to investigate the main effect of the relevance of base-rate information on the appropriateness of bank loan officers' confidence. Previous studies in psychology supported the notion that people usually tend to

under-utilise base-rate information in making probabilistic judgments (Kahneman and Tversky, 1973; Bar-Hillel, 1979; 1980a; 1980b; 1982; Tversky and Kahneman, 1982b; Bar-Hillel, 1984; 1990). This bias can be reduced in many ways. One such way, as discussed earlier in Section 2.5.12 of Chapter II, is based on the concept underlying the anchoring and adjustment heuristic (see also Section 2.5.3 for more detailed discussion of this heuristic). When two or more items of information are integrated in arriving at a probabilistic judgment, the more relevant information item will serve as an anchor and will dominate the judgment. The less relevant information item either will be ignored or will produce a minor adjustment to the initial judgment (the anchor).

If people use the anchoring and adjustment heuristic, their probabilistic judgments can be improved by increasing the relevance of base-rate information. The relevance of base-rate information is defined as the degree to which base-rate information is perceived as being relevant to a particular judgmental task (Bar-Hillel, 1980a). Previous studies in psychology showed that people who were given the more relevant base-rate information were more likely to use the given base-rate information in making probabilistic judgments (Ajzen, 1977; Carroll and Siegler, 1977; Bar-Hillel, 1980a; Tversky and Kahneman, 1982a).

Studies in psychology also showed that people tend to have more overconfidence when making probabilistic judgments for events with low base rates than for events with high base rates (Dunning *et al.*, 1990; Vallone *et al.*, 1990; Griffin and Tversky, 1992). In investigating the effects of the value of a base rate on appropriateness of confidence, Griffin and Tversky (1992) asked a group of students to imagine that they had three different biased foreign coins with a known bias of 3:2. Subjects were told that whether the bias of each coin was in favour of heads (H) or in favour of tails (T) was not known. Different base rates of the two hypotheses (H and T) were given. For one half of the subjects, the probability of H was 0.50 for the first type of

coin, 0.67 for the second type of coin, and 0.90 for the third type of coin. For the other half of the subjects, the base rates of H were 0.50, 0.33, and 0.10 respectively. Subjects were presented with samples of size ten, which included from five to nine heads. They were then asked to give their confidence that the coin under consideration was biased in favour of heads.

The results of Griffin and Tversky's study revealed that their subjects overweighed the strength of case-specific evidence and underweight the given base rates. It was also found that subjects were overconfident in the low base-rate condition (i.e., the base rates were 0.50, 0.33, and 0.10) and underconfident in the high base-rate condition (i.e., the base rates were 0.50, 0.67, and 0.90). Two other studies in social psychology also observed this pattern and found that their subjects' overconfidence was much more pronounced when the given base rates were low than when they were high (Dunning *et al.*, 1990; Vallone *et al.*, 1990).

Accounting studies also supported the notion that various types of subjects, including auditors and business students, tended to under-utilise base-rate information in probabilistic judgments (Swieringa *et al.*, 1976; Joyce and Biddle, 1981b; Johnson, 1983; Holt, 1987). Another accounting study was also found to support the premise that provision of the more relevant base-rate information will lead to better judgments. Kida (1984a) investigated the effect of the relevance of base-rate information on auditors' going-concern judgments. Auditors were randomly assigned to groups that differed in the relevance of base-rate information provided. The results revealed that auditors who were given the more relevant base-rate information were more likely to use the given base-rate information than those who were given the less relevant base-rate information. These accounting studies, however, did not address the effect of under-utilising base-rate information on judgment performance, such as appropriateness of confidence.

On the basis of the previous studies discussed above and the base rate of financial distress being relatively small, it follows that although bank loan officers may tend to have overconfidence due mainly to under-utilisation of base-rate information, they tend to have less overconfidence when they are given the more relevant base-rate information than when they are given the less relevant base-rate information. Therefore, the null hypothesis suggests that bank loan officers who are given the more relevant base-rate information do not tend to have less overconfidence than do those who are given the less relevant base-rate information. The alternative hypothesis can be stated as follows:

H2: Bank loan officers who are given the more relevant base-rate information tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do those who are given the less relevant base-rate information.

4.3.3 Hypothesis 3

The testing of this hypothesis attempts to investigate the main effect of the need for cognition (NC) trait of bank loan officers on the appropriateness of their confidence when predicting the probabilities of firms being in financial distress. NC was defined in Section 2.5.12.2 of Chapter II as the tendency of an individual to engage in and enjoy expending more cognitive effort to do a task (Cacioppo and Petty, 1982; Cacioppo *et al.*, 1984; Verplanken *et al.*, 1992).

Cognitive effort has been identified in Chapter II as being one major factor that determines human judgment performance. For example, the Principle of Bounded Rationality (Simon, 1955) suggested that people have a limited information

processing capacity. Therefore, cognitive effort has been recognised as a scarce resource (Simon, 1978). Up to a certain point, an increase in cognitive effort will lead people to increase their information processing capacity and thus improve their judgment performance (see Section 2.3 in Chapter II for more detailed discussion).

In BDT research within the Heuristics-and-Biases framework, several environmental factors were recognised to induce people's effort. For example, accountability was one such factor that would lead people to expend more effort on using cognitively complex rules (Tetlock, 1983a). Accountability was also found to lead people to be more aware of the determinants of their judgments and to have greater consistency and stability of the judgments (Hagafors and Brehmer, 1983). Moreover, accountability increased people's willingness to pay attention to all the evidence and modify initial impressions in response to contradictory evidence (Tetlock, 1983b). Furthermore, accountability was found to reduce the sunk cost effect in a personal finance context by directing people's attention to the irrelevance of sunk costs (Simonson and Nye, 1992). All these studies indicated that an increase in cognitive effort induced by accountability led to better judgments.

Previous studies also found that an increase in cognitive effort promoted appropriate confidence. For example, accountability was found to reduce the overconfidence effect in a personality-prediction context by increasing awareness of complexities in the behaviour of others (Tetlock and Kim, 1987). Providing incentives shares a similar effect on promoting cognitive efforts. It was found that giving an incentive led people to have more appropriate confidence, by making people less likely to assign very large or very small probabilities and therefore to perform better (Fischer, 1982). The contention that the degree of overconfidence decreases as the amount of cognitive processing in choice increases has consistently been supported in the psychology literature (Peterson and Pitz, 1988; Sniezek *et al.*, 1990).

In addition, high NC individuals were found to be more active in information processing and more effective in problem solving than low NC individuals (Heppner *et al.*, 1983). High NC individuals were also found to recall more message arguments (Cacioppo *et al.*, 1983), to be more affected by argument quality but not the attractiveness of an endorser (Ahlering, 1987; Haugtvedt *et al.*, 1988), and to process more information items (Verplanken *et al.*, 1992).

Moreover, in investigating the primacy bias when evaluating a person described by serially presenting various trait adjectives, Ahlering and Parker (1989) revealed that high NC subjects were found to commit the primacy bias to a lesser extent than low NC subjects. All the studies relating to the NC literature suggested that high NC individuals tend to have better judgment performance than low NC individuals.

Following this argument, high NC bank loan officers are expected to expend more cognitive effort and thus have more appropriate confidence than low NC bank loan officers when predicting the probabilities of firms being in financial distress. Therefore, the null hypothesis suggests that high NC bank loan officers do not tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers. The alternative hypothesis can be stated as follows:

H3: High NC bank loan officers tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers.

4.3.4 Hypothesis 4

The testing of this hypothesis attempts to investigate the moderating effect of NC on the relation between the relevance of base-rate information and appropriateness of confidence. Similarly, the theoretical support related to these two factors, as discussed earlier in Sections 4.2.3 and 4.2.4, is also applicable to developing this hypothesis.

The moderating effect of NC on information processing biases was explored by Ahlering and Parker (1989). They asked a group of students to evaluate a person who was described by serially presenting some trait adjectives. Ahlering and Parker suggested that their subjects would follow the "attention decrement hypothesis" in this task. This hypothesis proposed that the weight given by the subjects to each adjective for the overall judgment decreased with each successive adjective, resulting in a primacy bias in which those trait adjectives presented earlier were weighted higher than those presented later.

The results supported both the "attention decrement hypothesis" and the moderating effect of NC on the primacy bias. Although high NC subjects were found to commit the primacy bias similar to low NC subjects, the extent of this bias committed by high NC subjects was found to be significantly lower than that committed by low NC subjects. These results provided additional evidence to the contention that high and low NC individuals process information differently.

Ahlering and Parker (1989) also contended that the judges' NC trait might moderate other information process biases, and the base-rate fallacy had specifically been highlighted (p. 314):

> "...cognitive miserliness may be moderated by individual differences in information processing. This opens the door for investigation into how need for cognition *moderates other information processing biases such as the base rate fallacy*, the availability heuristic, the actor-observer bias, and others." (emphasis added)

The theory described above suggests that the bank loan officers' NC trait is expected to have moderating effect on the tendency to use base-rate information when predicting the probabilities of firms being in financial distress. The difference between high and low NC bank loan officers in using base-rate information is expected to be more pronounced when the less relevant base-rate information is given to them because this base-rate information is more likely to be under-utilised in this situation. Therefore, high NC bank loan officers are expected to utilise base-rate information more properly and to have more appropriate confidence than low NC bank loan officers in this situation. When the more relevant base-rate information is given, both high and low NC bank loan officers are expected to use this base-rate information to a similar extent. Their judgments are thus expected to be similar.

Following this argument, the null hypothesis suggests that high NC bank loan officers do not tend to have less overconfidence than do low NC bank loan officers when they are given the less relevant base-rate information. Conversely, high NC bank loan officers tend to have less overconfidence when they are given the more relevant base-rate information. The alternative hypothesis can be stated as follows:

H4: High NC bank loan officers tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers when they are given the less relevant base-rate information. Conversely, high NC bank loan officers do not tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers when they are given the more relevant base-rate information.

4.3.5 Hypothesis 5

The testing of this hypothesis attempts to investigate the main effect of the perceived informativeness of case-specific evidence on the appropriateness of bank loan officers' confidence. The perceived informativeness of case-specific evidence is defined as how informative case-specific evidence is perceived to help predict the probability that a firm will or will not be in financial distress. The more informative case-specific evidence enables a subject to judge a specific firm as being either very likely (say > 70%) or very unlikely (say < 30%) to be in financial distress. On the contrary, the less informative case-specific evidence (say between 30% and 70%) does not help the subject much make such a judgment.

The Bayesian rule indicates that although base-rate information is always relevant, its impact on the normative probability assessment decreases as case-specific evidence becomes more informative. Specifically, when case-specific evidence is highly informative, base-rate information has a lesser impact on the normative probability which is dominated by case-specific evidence alone. As case-specific evidence

becomes less informative, the normative probability becomes regressive or closer to the base rate[5].

For example, assuming that the base rate of financial distress is 30%, Table 4.1 shows the relationships between case-specific evidence, the normative probability, and their difference:

Table 4.1

Relationships Between Case-Specific Evidence, the Normative Probability, and the Difference between Case-Specific Evidence and the Normative Probability

Case-Specific Evidence	The Normative Probability	Difference
0.00	0.00	0.00
0.10	0.05	0.05
0.20	0.10	0.10
0.30	0.16	0.14
0.40	0.22	0.18
0.50	0.30	0.20
0.60	0.39	0.21
0.70	0.50	0.20
0.80	0.63	0.17
0.90	0.79	0.11
1.00	1.00	0.00

[5] To illustrate this, consider the events of financial distress [D] and non-financial distress [D'] in a prediction problem in which case-specific evidence [E] and the base rates of the events [P(D) and P(D')] are combined to form the normative probability of financial distress and financial non-distress [P(D/E) and P(D'/E)]. According to the Bayesian rule, the optimal integration of case-specific evidence and the base rates in odds form is given by:

$$\frac{P(D/E)}{P(D'/E)} = \frac{P(E/D)}{P(E/D')} \times \frac{P(D)}{P(D')}$$

The informativeness of case-specific evidence is given by the value of the conditional likelihood, and the conditional likelihood ratio [P(E/D) / P(E/D')] indicates the degree to which the sample favours financial distress over financial non-distress. When case-specific evidence is less informative, the conditional likelihood is approaching 0.50 from either the upper or lower direction. In this case, the value of this likelihood ratio approaches one and the normative probabilities are governed by the base rates of P(D) and P(D'). However, the base rates have a minimal impact on predictions, when case-specific evidence is highly informative and the conditional likelihood approaches either 0.00 or 1.00. In this case, the value of the likelihood ratio approaches either zero or infinity (Johnson, 1983, pp. 80-81).

Table 4.1 suggests that the adjustments from case-specific evidence to the corresponding normative probability are minimal when case-specific evidence is highly informative; that is when case-specific evidence is close to either 0.00 or 1.00. However, the amounts of these adjustments increase as case-specific evidence becomes less informative; that is when case-specific evidence is approaching 0.50 from either direction.

Studies in psychology showed that individuals were found to behave in a pattern similar to the Bayesian rule when making probabilistic judgments. As mentioned previously in Section 2.5.12 of Chapter II, the anchoring and adjustment heuristic predicts that when two or more items of information are integrated in arriving at a probabilistic judgment, the more relevant item of information will serve as an anchor and will dominate the judgment. For example, the results of Ginossar and Trope's (1980) study suggested that base-rate information was under-utilised when case-specific evidence was perceived as being informative. However, base-rate information was found to be used properly when case-specific evidence was perceived as being uninformative.

As mentioned earlier in Section 3.3.10.2 of Chapter III, Johnson (1983) also supported the premise that the less informative case-specific evidence promoted the use of base-rate information in a going-concern judgment task. To investigate the tendency to ignore the base rates of bankruptcy and to rely exclusively on the representativeness of a company's financial profile, Johnson (1983) asked a group of students to make going-concern judgments. The results indicated that although base-rate information was in general under-utilised by the subjects, this information was more likely utilised when a firm's financial profile was perceived as being of little

value in discriminating between bankruptcy and nonbankruptcy than when a firm's financial profile was perceived as being informative.

However, Johnson investigated only whether base-rate information was under-utilised. The effect of under-utilisation of base-rate information on prediction performance was not investigated in his study. It is therefore still unknown whether a less informative corporate financial profile will lead to more appropriate confidence than a more informative corporate financial profile.

Accordingly, if base-rate information is not utilised by the subjects when they perceive case-specific evidence as being less informative, they are expected to have more overconfidence than when they perceive case-specific evidence as being more informative, as it is suggested by the Bayesian rule and illustrated in the example shown in Table 4.1. Conversely, if base-rate information is used by the subjects when they perceive case-specific evidence as being less informative, they are not expected to have more overconfidence than when they perceive case-specific evidence as being more informative, as it was implied from the results of Ginossar and Trope's (1980) study.

Since the extant literature in psychology and accounting suggests that people tend to under-utilise base-rate information, the extent of bank loan officers' appropriate confidence is expected to follow more closely the pattern of the normative probability described by the Bayesian rule rather than the results of Ginossar and Trope. Therefore, bank loan officers are expected to have less overconfidence when they perceive case-specific evidence as being more informative, than when they perceive case-specific evidence as being less informative.

Following this argument, the null hypothesis suggests that bank loan officers who perceive case-specific evidence as being more informative do not tend to have less

overconfidence than those who perceive case-specific evidence as being less informative. The alternative hypothesis can be stated as follows:

H5: Bank loan officers who perceive case-specific evidence as being more informative tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do those who perceive case-specific evidence as being less informative.

4.4 Chapter Summary

The aim of this chapter was to develop the research model and hypotheses for the current study on the basis of the four research opportunities identified from the literature reviewed in the last two chapters. The focus of the first research opportunity was on examining whether bank loan officers have appropriate confidence when predicting the probabilities of firms being in financial distress. The other research opportunities focused on testing the three selected potential factors affecting the appropriateness of bank loan officers' confidence (i.e., the dependent variable). These factors were the independent variables of the current study and included the relevance of base-rate information, the bank loan officers' NC trait, and the perceived informativeness of case-specific evidence. The research model delineated the various relationships among these variables. Five research hypotheses were then proposed to test these relationships and their underlying logic were discussed. The next chapter will describe the research method and design used to test these hypotheses.

CHAPTER V

RESEARCH METHOD AND DESIGN

5.1 Introduction

The purpose of this chapter is to describe the research method and design used to test the five research hypotheses developed in the last chapter. The remainder of this chapter is organised around eight sections. Section 5.2 first describes the research method of the current study. Section 5.3 then outlines the experimental design which is a two-group design with before and after treatment observations. Section 5.4 discusses how and why the subjects of the current study were selected for the experiments. Section 5.5 explains some of the major issues in constructing the experiment instrument, whereas Section 5.6 describes the procedures of administrating the experiments. Section 5.7 gives the details of measuring the independent and dependent variables. Section 5.8 discusses the data analysis methods used for testing the research hypotheses, and the assumptions of these methods are specified. Finally, Section 5.9 provides a summary of the chapter.

5.2 Research Method

Research methods can broadly be classified into experimental (causal-type) and non-experimental (correlational-type) (Spector, 1981; Brown and Melamed, 1990). The major difference between these two research methods is the degree to which an investigator can control specific conditions (events or situations). The experimental method allows the investigator to manipulate certain conditions, so that causal relationships can be established, if any. In the non-experimental method the

investigator can only observe these conditions in naturally occurring environments, so that any association between two variables can be examined.

Calder, Phillips and Tybout (1981) identified the conditions under which the experimental or non-experimental research method should be used. They argued that when the research goal is for theory testing, the experimental method is preferred because it allows the strongest test. This method permits the investigator to minimise the possibility that third variables cause any observed relation between the independent and dependent variables. This method also allows the investigator to establish that the independent variable precedes the dependent variable in time, thus ruling out the possibility that the dependent variable initiates changes in the independent variable. These two features are important for eliminating the most plausible threats to the conclusion that a demonstrated statistical relationship between the independent and dependent variables implies causality (Cook and Campbell, 1976). Since the focus of the current study is theory testing, the experimental method should be and was actually used as the primary research approach.

One major limitation of the experimental method is the realism of the experimental task. However, if the difference between the experimental task and the corresponding real setting is not great and this difference does not have any significant effect on the dependent or independent variables, this method is deemed to be appropriate. In the current study, the experimental task was designed and conducted as realistically as possible in order to cater for this limitation. First, the ten firms given in the experiment instrument for the subjects to make financial distress predictions were real industrial firms publicly listed on the Stock Exchange of Hong Kong Limited (SEHK). Second, pilot interviews with some senior bank loan officers were conducted to ensure that the financial ratios provided to the subjects were commonly used by them in practice. Third, the experiments were conducted in the subjects' offices during office hours.

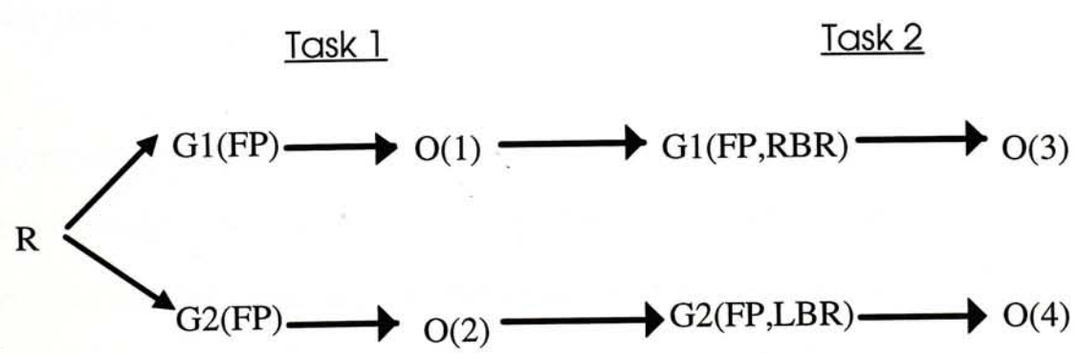
The experimental method was commonly adopted to solicit the judgments from bank loan officers by most of the relevant behavioural decision research in accounting (e.g., Kennedy, 1975; Libby, 1975a; 1975b; Abdel-khalik and El-Sheshai, 1980; Casey, 1983; Houghton, 1984; Houghton and Sengupta, 1984; Houghton and Robinson, 1989; Breda and Ferris, 1992). The experimental method was also the most popular research method for accounting researchers to investigate the appropriateness of confidence (e.g., Tomassini *et al.*, 1982; Solomon *et al.*, 1985; Casey and Selling, 1986; Moeckel and Plumlee, 1989; Dilla *et al.*, 1991; Ismail and Simnett, 1991; Selling, 1993; Mladenovic and Simnett, 1994). Therefore, the experimental method is considered to be a more appropriate research method than the non-experimental or correlational method for the current study.

5.3 Experimental Design

The experimental design adopted in the current study is a two-group design with before and after treatment observations. Since the relevance of base-rate information is the primary and only manipulative independent variable in the experiments, each subject was therefore first randomly assigned (R) to one of these two groups before Task 1 was conducted: Group 1 with the more relevant base-rate information (G1(FP)) and Group 2 with the less relevant base-rate information (G2(FP)). Each subject in either group was given the same ten corporate financial profiles (FP) one at a time and then asked to assess the financial distress likelihood (observation O(1) or O(2)) for each of these ten corporate financial profiles in Task 1. Therefore, each subject had to make ten assessments of the financial distress likelihood before he/she received base-rate information treatment in Task 2.

In Task 2, subjects were given additional base-rate information. Subjects in the more relevant base-rate information group (G1(FP, RBR)) were provided with the base-rate information which was more industry-specific and causal than the base-rate information provided to the subjects in the less relevant base-rate information group (G2(FP, LBR)) (see Section 5.7.1 for more detailed discussion of the relevance of base-rate information). Subjects in both groups were given back their own financial distress likelihood estimations in Task 1 and were then asked again to assess the probability of financial distress (observation O(3) or O(4)) for each of the same ten corporate financial profiles. The incremental effect of the relevance of base-rate information can then be measured by the difference between [O(3) - O(1)] and [O(4) - O(2)]. This two-group design with before and after treatment observations is shown in Figure 5.1.

Figure 5.1 Two-Group with Before and After Treatment Observations Experimental Design



Possible biases such as history, maturation, testing, instrumentation, experimental mortality, selection-maturation interaction, reactive effect of testing, subject selection biases, and reactive effects of experimental arrangements in an experiment, had been well controlled for in the current study and it is therefore believed that they would not cause any visible effect on the reliability of the findings.

5.4 Subjects

Bank loan officers are frequently required to evaluate whether their clients will be in financial distress by using information extracted from the clients' financial statements. Bank loan officers from the Bank of China Group were selected as the subjects for the current study. This Group is a major banking group in Hong Kong in terms of the number of member banks. It consists of 14 sister banks of which most of them are incorporated in mainland China. Each of these member banks has its own branch network and independent responsibility for its profit and loss. Some of the operations among the member banks in the Group are, however, controlled centrally. These operations, among others, include the computerised banking systems and lending policy.

As Hong Kong is going to return to mainland China in 1997, the importance of this banking group to the economy of Hong Kong has been growing rapidly in recent years. For example, the Bank of China has been authorised to issue local bank notes since 1994. In view of its size and its increasing influence in the local society, bank loan officers of this banking group were selected as the sample frame of the current study. Although restricting its external validity, choosing all loan officers from the same banking group can also increase the internal validity of the study results in this sense.

Since there were only limited potential subjects available in the chosen banking group, and in view of the resource constraints in completing the current study, the sample size was targeted at 50. The number of subjects used for the current study was also determined by making reference to some previous studies of behavioural decision research in financial distress prediction which used similar subjects and experimental designs. For example, Libby (1975a) used 43 bank loan officers for an experimental design with three between-subjects variables. Houghton and Sengupta (1984) used 45 bank loan officers for an experimental design with two between-subjects variables. Similarly, Breda and Ferris (1992) used 32 bank loan officers for an experimental design with two between-subjects variables.

The number of subjects determined in the current study also took account of the discussion by Keppel (1982, p.336) regarding the minimum sample size for a treatment cell. Keppel argued that to achieve the desired reliability associated with each of the basic treatment means, the minimum sample size for a treatment cell acceptable to researchers in social science ranges from 8 to 12 subjects. This number also depends upon the size of the within-groups variance. The two between-subjects variables with two levels each in the current study resulted in four treatment cells. The minimum sample size should be in the range of 32 (4 x 8) to 48 (4 x 12) subjects. Therefore, the size of 50 subjects used in the current study should also be able to satisfy the minimum sample size as suggested by Keppel.

The bank loan officers recruited had at least one year's working experience in analysis or administration of commercial loan applications. Since co-operation from the subjects is crucial to the success of any experiment, support from the management of the chosen banking group was important for their bank loan officers' active participation in the current study. As it was impossible to obtain a list of all bank loan officers in the chosen banking group, the sample of subjects in the current study was selected through contact with the management of the banking group. A senior

manager of the banking group, who had voluntarily participated in co-ordinating the recruiting project, contacted the potential subjects directly on a non-random basis and solicited their willingness to participate in the experiments. Ultimately, 50 bank loan officers agreed to participate.

5.5 Construction of the Experiment Instrument

The experiment instrument was divided into four parts. The first part provided an introduction of this research to the subjects. The research objective was first given and the definition of a firm in financial distress was then provided. The importance of the subjects' participation in the research and their contribution to the research was also emphasised. Finally, the subjects were asked to indicate whether they would like to have a report on the results of the research. In the second part, the subjects were asked to assess the "financial distress likelihood" of the ten given firms based on the financial ratios contained in their respective corporate financial profiles. Each profile and its related assessment question were presented in a separate page.

The third part contained additional base-rate information (either the more relevant type or the less relevant type). The subjects were then asked to make a "financial distress probability" estimation for each of the ten original financial profiles. The last part of the instrument measured the information processing characteristic of the subjects (i.e., the NC trait) as a subject variable. A sample copy of the experiment instrument both in English and Chinese can be found in Appendix A and Appendix B respectively.

5.5.1 Selection of Sample Firms for Prediction Tasks

There were two major purposes in selecting a portfolio of sample firms in the current study. The first purpose was to include the chosen firms in the experimental instrument for the subjects to make financial distress predictions. The second purpose was to extract the appropriate financial ratios to be included in the financial profiles. The rest of this section is divided into four parts. Section 5.5.1.1 first provides the definition of a firm being in financial distress. With this given definition, Section 5.5.1.2 describes the process of identifying those firms in financial distress. Section 5.5.1.3 then discusses how the matching healthy firms were selected in order to identify those specific financial characteristics that could be used to predict firms being in financial distress. Finally, Section 5.5.1.4 explains how the sample firms were chosen to be included in the experiment instrument.

5.5.1.1 Definition of Firms being in Financial Distress

While most behavioural studies of financial distress prediction in the U.S. and Australia mainly included firms that had filed bankruptcy (Libby, 1975b; Abdel-khalik and El-Sheshai, 1980; Casey, 1980a; 1980b; Zimmer, 1980; Casey, 1983; Houghton, 1984; Casey and Selling, 1986; Breda and Ferris, 1992; Selling, 1993), some other studies used a broader scope for defining financial distress and included firms not only in bankruptcy, but also in insolvency, loan default or asset liquidation due to financial difficulty (Chalos, 1985; Chewning and Harrell, 1990; Stocks, 1991). In fact, both bankruptcy and technical insolvency can be considered as legal forms of firm failure and the difference between these two types of firm failure is only in degree of financial difficulty.

A firm in financial distress is defined in the current study as a publicly listed company that has been suspended or de-listed from listing on the SEHK due to financial difficulty (e.g., inability to pay debts when they come due, bankruptcy, loan default, insolvency or asset liquidation) during the period of 1986 to 1992. This broader definition was adopted by the current study for two reasons. First, although bank loan officers pay much attention to whether their clients will be bankrupt, any events that will impair repayment of loans attract the same attention from them. These events include loan default or liquidation of major assets due to financial difficulty. This definition of financial distress is therefore considered to be more appropriate for bank loan officers to make lending decisions in practice. Second, publicly listed companies in Hong Kong that filed bankruptcy were rare. With more sample firms under this broader definition of financial distress, the subjects would not be so easily able to guess the real identity of these firms in the experiment. Thus, this definition of financial distress could avoid some possible biases that decreased the internal validity of the study results.

The sample firms selected for the current study were listed during the period of 1986 to 1992. Such restriction on the selected period was due to the fact that the SEHK was incorporated in 1986 and complete records for publicly listed companies have been readily available only since then. In addition, although the current study attempted to include the latest financial statement information available, the PACAP Database 1993, a major source for the financial information of publicly listed companies in Hong Kong, includes the information of the publicly listing companies in Hong Kong only up to the end of 1992.

5.5.1.2 Identification of Firms in Financial Distress

Suspended or de-listed firms during the said period could be identified from *The Weekly Stock Price Quotations* and the yearly *Fact Books* (the SEHK, 1986; 1987; 1988; 1989; 1990; 1991; 1992) published by the SEHK. The reasons for these suspensions and de-listings were found by studying the major events and the history of the firms concerned as documented in *Wardley Cards*. Unclear reasons were further investigated by referring to the company news published in financial newspapers, such as *The Hong Kong Economic Journal*, around the days of suspension or de-listing.

Twenty-one firms were initially identified as being in financial distress during the said period. Of these firms, four companies in finance (including commercial banks) were deleted because they were governed by different regulations and their financial statements differed substantially from those of non-finance companies. A further four firms were deleted due to unavailability or incompleteness of financial statements. The final sample consisted of 13 financially distressed firms.

5.5.1.3 Selection of Healthy Firms

To identify those financial characteristics that could be used to predict firms being in financial distress, a sample of healthy firms were found by matching their industry type, firm size and fiscal year of financial statements with those of the sample of financially distressed firms as identified in Section 5.5.1.2. These matching criteria were recognised as the dimensions most commonly used in the previous studies (Beaver, 1966; Altman, 1968; Deakin, 1972; Casey and Bartczak, 1985; Tai and Tai, 1986; Platt and Platt, 1990; Baldwin and Glezen, 1992; Koh, 1992; Platt, Platt and Pedersen, 1994). In the current study, the amount of total assets was used as the

proxy for firm size, and the industry codes that were assigned by the SEHK to the firms were adopted as the proxy for their industry type. By using these proxies, each financially distressed firm identified in the current study was matched with two healthy firms by industry type, the fiscal year of financial statements, and firm size so that a portfolio of mixed firms could be made available for this prediction task. The reason for using this method of matching, instead of using the commonly used method of one-to-one matching, was to satisfy the basic assumption of the statistical tool on sufficient sample size for identifying useful financial ratios from a sample of potential ratios (see Section 5.5.2.1 for more detailed discussion). By using this matching method, the final sample contained 13 financially distressed firms and 26 healthy firms.

There are both advantages and disadvantages of using the matching method to select a sample of healthy firms for investigating the characteristics of firms in financial distress. On the one hand, this method provides an efficient way to achieve a statistical power which can only be obtained from using a large sample. On the other hand, the criteria used for matching will not be identified as important characteristics of firms in financial distress even they actually are.

5.5.1.4 Sample Firms in the Instrument

Ten sample firms were selected to be included in the experiment instrument and all the subjects were provided with these same sample firms for making the financial distress predictions. This number of sample firms was determined by the feedback from the pilot interviews with four experienced bank loan officers who suggested this number of sample firms as the acceptable maximum for bank loan officers to participate in such an experiment (see Section 5.5.5 for more detailed discussion of the pretest of the instrument). In order to match the treatment financial distress base

rate of 30% adopted in the experiment (see Section 5.7.1), three firms were randomly selected from the 13 firms in financial distress as identified earlier in Section 5.5.1.2. The six healthy firms matching these three firms in financial distress were also included in the instrument. The last healthy firm was randomly selected from the remaining 20 healthy firms. Altogether there were a total of ten (3 + 6 + 1) financial profiles included in the instrument.

5.5.2 Selection of Financial Ratios

The types of financial ratios included in the corporate financial profiles were selected on the basis of two criteria. First, the financial ratios selected should actually be useful for predicting firms being in financial distress. A large number of financial ratios that had been identified as being useful for predicting firms being in financial distress in the literature were tested by logit analysis in the current study. Eight useful financial ratios were finally identified. The results of this logit analysis are presented in the next section, Section 5.5.2.1. Second, the financial ratios selected should also be perceived as being useful by bank loan officers for this prediction task (see Section 5.7.3 for a discussion of the distinction between "useful" and "informative"). To obtain ideas about which financial ratios were perceived to be useful, pilot interviews with four experienced bank loan officers were conducted. These interviews and the results are discussed in more detail in Section 5.5.2.2. As to be discussed later, by consolidating the findings from these two procedures, nine financial ratios were finally included in the experiment instrument.

5.5.2.1 Logit Analysis

Logit analysis is the most popular technique adopted by those recent studies examining the characteristics of financially distressed firms. Its S-shaped curve of logistic distribution function is used to specify the functional relationship between the firm's financial ratios and its financial distress likelihood:

$$p(i) = 1 / [1 + e^{-\beta \; x(i)}]. \qquad (5.1)$$

where $p(i)$ is the probability that the firm i will be in financial distress in the coming year, $x(i)$ is a vector of financial ratios of the firm i, and β is a vector of unknown parameters to be estimated. After rearranging Equation (5.1), a logit model can also be expressed as:

$$Logit = ln[p(i) / (1 - p(i))] = \beta \; x(i) \qquad (5.2)$$

A logit model can be used to estimate the probability of an event that is related to some measurable factors. Logit estimation can also be used to compare the relative importance of the explanatory variables in determining the likelihood of an event.

Little guidance can be found from the literature as to which financial ratios are useful for this prediction task. For this reason, a large number of financial ratios that were examined in previous financial distress studies were initially included in the model as the potentially useful ratios. To single out the most useful financial ratios from this large pool of potential ones, a sample of firms composed of both firms in financial distress and healthy firms were needed for statistical analysis. These sample firms have already been identified in Sections 5.5.1.2 and 5.5.1.3, and included 13 firms in financial distress and 26 healthy firms. Financial statement information required to compile the financial ratios of these sample firms was extracted from the PACAP Database. Those ratios that required information not available in this Database were dropped to preserve consistency and reliability of data. Out of the original 40 ratios, only 36 financial ratios were left for further investigation.

Of these 36 financial ratios, the ratio of sales to total shareholders' equity was dropped because this ratio had a value of both positive and negative infinities as the total shareholders' equity of a firm approached zero. Two other financial ratios (i.e., working capital to total assets, and total liabilities to total assets) were also dropped because these two ratios were linear combinations of the other existing ratios. Specifically, working capital to total assets was equivalent to current assets to total assets minus current liabilities to total assets, whereas the ratio of total liabilities to total assets was equivalent to one minus the ratio of total shareholders' equity to total assets. The elimination of these two ratios was necessary as this statistical tool requires that no independent variable is a linear combination of the other independent variables (Aldrich and Nelson, 1984; DeMaris, 1992). Finally, a total of 33 potential financial ratios were put in the logit analysis. The results of the analysis indicated that the model of one year prior to financial distress contained eight significant explanatory variables as follows:

- Current assets to current liabilities
- Quick assets to total assets
- Working capital to equity
- Sales to cash
- Sales to total assets
- Sales to equity
- Total debt to equity
- Total debt to total assets

The details of the prediction model and the findings will be reported in Section 6.3 of Chapter VI, and the computer output of the logit analysis can be found in Appendix C.

5.5.2.2 Pilot Interviews

To ensure that the financial ratios identified by the logit analysis were also perceived as being useful by bank loan officers for predicting firms being in financial distress, interviews with four senior bankers (not included in the final sample) from the Bank of China Group with extensive experience in commercial lending were conducted. These pilot interviews also allowed the author to become more familiar with the real practice of the loan decision process and to provide insights into refining the research model of the current study. The average banking experience of these interviewees was 14 years, ranging from 10 to 20 years. Their average lending experience was 9 years, ranging from 8 to 10 years. The interviews were unstructured with a purpose of giving more opportunities to the interviewees to express their ideas. Each of these interviews lasted for about half an hour.

The first interview confirmed that financial ratio analysis was important for evaluating a commercial loan application. In general, a large number of financial ratios were used to analyse applicants' financial strengths. Their focus was not only on particular types of ratios, but also on the consistency among various ratios. Six types of information were particularly highlighted as being useful. Of these six types of information mentioned, five could be found in the client firms' financial statements and included liquidity, leverage, turnover, profitability and security. Some examples were cited for each type of information, but the interviewee emphasised that these examples were not exhaustive. For instance, liquidity included working capital ratio; leverage included debt ratio; turnover included sales to total assets; profitability included net income to total assets and return on investment; and security included the amount of various classes of assets. Finally, some non-financial information was also considered to be important for their evaluation, even though it might not be given in financial statements. The latter information included the financial strength of a firm's directors, their management ability and the firm's industry risk.

The second interview suggested similar financial ratios, except that security was not mentioned. Also, non-financial factors, such as the company background and the relationships with its bankers, were mentioned. The third interview provided further support for the results of the previous two interviews. Liquidity (such as current ratio and quick ratio), turnover (such as sales to total assets) and profitability were suggested to be the important factors. In addition, the interviewee suggested looking into the fixed costs structure of a firm. However, similar to the second interview, security was not mentioned. Finally, non-financial factors, such as industry risk and the character of management, were also mentioned.

The fourth interview also indicated similar factors. For example, liquidity, particularly the information on cash flow statement, was highlighted. Leverage, such as debt ratio, was also mentioned. Furthermore, security was considered to be important. Some insightful comments were given on the profitability of a firm. The interviewee suggested that although profitability was not a crucial factor in determining whether a firm would be in financial distress, most of the bankers in Hong Kong were reluctant to grant loans to unprofitable settings.

In order to understand more about the real practice of the loan decision process of the Bank of China group, these interviewees were also asked to indicate whether any decision aids were commonly used when evaluating a loan application. All of them indicated that very few formal decision aids were regularly used in their banking group.

5.5.2.3 Final Financial Ratios Used in the Instrument

Since all the eight financial ratios identified by the logit analysis were also mentioned by the four senior bank loan officers in the pilot interviews as useful financial ratios

for this prediction task, all these ratios were included in the instrument. However, the profitability ratios of a firm, as suggested by these bank loan officers, were not included in the results of the logit analysis. The ratio of net income to total assets (also known as return on investment), a profitability ratio mentioned by all these bank loan officers, was also added to the list in order to cater for the information need of the subjects. Therefore, there were a total of nine financial ratios contained in the instrument as shown below:

1. Liquidity
    - Current assets to current liabilities
    - Quick assets to total assets
    - Working capital to equity
2. Turnover
    - Sales to cash
    - Sales to total assets
    - Sales to equity
3. Leverage
    - Total debt to equity
    - Total debt to total assets
4. Profitability
    - Net income to total assets

5.5.3 Modification of the Need for Cognition Scale

The last part of the experiment instrument was used to measure the information-processing characteristic of the subjects, that is their need for cognition (NC) trait. This trait was measured by the 18-item NC scale as developed by Cacioppo *et al.*, (1984). This scale was well tested and found to have one dominant factor that accounted for 37% of total variance and the Cronbach's alpha coefficient was +0.90

(Cacioppo *et al.*, 1984). Subjects were asked to indicate their degree of agreement or disagreement to each statement on a seven-point likert scale, ranging from +3 to -3. The points of +3, +2 and +1 were equivalent to "strong", "moderate" and "slight" agreement with the statement respectively. The point of 0 represented neutral. The points of -1, -2 and -3 indicated "slight", "moderate" and "strong" disagreement with the statement respectively.

In order to ensure that this NC instrument could be understood by the subjects, it was passed to a linguistic and business communication lecturer in a tertiary institute in Hong Kong for comments. Overall, he found that the instrument should be comprehensible to bank loan officers. However, he also found that some of the questions in the original instrument had grammatical problems and a few others were difficult for Hong Kong business people to understand. Therefore, some wordings of the original questions were modified upon his recommendations.

For example, "would prefer" in Question 1 and Question 15 was replaced by a simpler word "prefer". "Thinking is not my idea of fun" in Question 2 was changed to "Thinking is no fun for me". The word "deliberating" in Questions 6 and 18 was changed to "thinking". "I prefer to think about small, daily projects to long-term ones" in Question 8 was changed to "I prefer thinking about small, daily projects to thinking about long-term ones". "The idea of relying on thought to make my way to the top appeals to me" in Question 10 was changed to "I like to rely on thinking to make my jobs perfect". These modifications did not intend to change the meanings of the original questions; they only made the questions clearer and more understandable to the subjects.

5.5.4 Translation of the Experiment Instrument

Since Chinese language is commonly used in the Bank of China Group and all the subjects of the current study are Chinese, the original instrument in the English version was translated into Chinese to provide the subjects with an option to select their preferred language (in fact, all these subjects selected the instrument in the Chinese version in the experiments). In order to ensure that the experiment instruments of the two versions were equivalent, back translation method (Brislin, 1980) was used. This method has been commonly adopted for the purpose of doing cross-cultural research.

After the instrument was prepared in English, a bilingual who has extensive experience in commercial lending and translation was asked to translate the instrument into Chinese. The use of a translator with extensive banking experience was to ensure that the instrument was written in a language understandable to the subjects. A second bilingual was asked to independently translate the Chinese instrument back into English. The two versions were then compared by the author to identify any discrepancies. Some minor discrepancies were found and resolved with the two translators together.

5.5.5 Pretest of the Experiment Instrument

The preliminary experiment instrument was pretested by four experienced bankers who had also participated in the pilot interviews as discussed earlier in Section 5.5.2.2. Some helpful comments were solicited from them. Specifically, they considered that the original instrument was too long and time consuming for bank loan officers to complete. On the basis of their recommendations, the number of firms included in the instrument was reduced from the original 15 to final ten. Some

other minor adjustments to the instrument were also made to make it more easy to follow. These changes aimed to elicit better responses from the subjects.

5.6 Administration of Experiment

Altogether 50 bank loan officers were interviewed for collecting the needed data to test the hypotheses. All interviews were conducted in the subjects' offices during the office hours. Before arrival at each subject's office, the subject had been randomly assigned to one of the two base-rate information groups. The experiment instrument was assembled in a booklet and distributed to each subject personally at the beginning of the interview.

In an introduction, subjects were first given the definition of a firm being in financial distress. The importance of the subjects' participation in the current study and their contribution to this research were also emphasised. The purpose was to motivate them to undertake the experiment seriously. Also, the instructions given at the beginning of the instrument stressed the importance of answering the questions for each sample firm independently and according to the order they appeared in the booklet.

The experiment was divided into two consecutive tasks. In Task 1, subjects were asked to assess how likely it was each of the ten given sample firms (financial profiles) would be in financial distress in the coming year. All subjects were given the same ten sample firms. Subjects were told that these ten industrial firms were real firms and publicly listed in Hong Kong during the period from 1986 to 1992. These firms included both firms in financial distress and healthy firms. The financial ratios of a firm in financial distress were extracted from its annual report one year before its financial distress, while the financial ratios of a healthy firm were extracted from one

of its annual reports selected from the same period. Subjects were also told that the order of firms and the order of financial ratios were presented to them in random.

After this, subjects were given the financial ratios of each firm on a separate page, and were asked to assess how likely it was the specific firm would be in financial distress in the coming year. This likelihood was expressed by a number ranging from 0 (i.e., the firm certainly would not be in financial distress in the coming year) to 100 (i.e., the firm certainly would be in financial distress in the coming year), while 50 represented indifference. When the subjects had answered this same question for all the ten firms, Task 1 of the experiment was completed.

In Task 2 of the experiment, each subject was given additional base-rate information along with the same corporate financial profiles given in Task 1 and his/her estimation of the financial distress likelihood of these firms. Subjects were asked again to estimate the probability that each of the sample firms would be in financial distress in the coming year. The specific base-rate information received by a subject depended on the relevance group he/she had been assigned (see Section 5.7.1 for the manipulations of the relevance of base-rate information). Finally, subjects were asked to complete the modified NC instrument.

5.7 Operationalisation and Measurement of Variables

5.7.1 Relevance of Base-Rate Information

The relevance of base-rate information was manipulated by assigning each subject randomly to one of the two groups: the more relevant base-rate information and the less relevant base-rate information. Both groups had the same financial distress base

rate of 30%, but their relevance was different. Subjects in the less relevant base-rate information group were simply given the general base-rate information as follows:

> "The ten (10) given corporate financial profiles were in fact selected randomly from 100 firms of which 30 firms have been in financial distress and 70 firms have not been in financial distress."

The description of this general base rate of 30% followed those used by the psychology researchers when investigating the base-rate fallacy (Kahneman and Tversky, 1973; Bar-Hillel, 1979; 1980a; 1980b; 1982; Tversky and Kahneman, 1982a; Bar-Hillel, 1984). The description of this general base rate was also adopted by accounting studies in investigating auditors' going-concern judgments (Johnson, 1983; Kida, 1984a).

In contrast, subjects in the more relevant base-rate information group were provided with the more specific base-rate information as follows:

> "The ten (10) given corporate financial profiles were in fact selected randomly from a sample of 100 firms in an industry of which 30 firms have been in financial distress and 70 firms have not been in financial distress. This industry was regarded as risky in terms of very keen competition in the industry and highly fluctuating demands for its products."

Specificity was operationalised as industry specific and causal (Bar-Hillel, 1980a). The industry-specific base rate indicated that the 30 firms in financial distress were selected from an industry, of which the targeted firm was a member (Carroll and Siegler, 1977). This operational definition of the specific base rate was similar to that adopted by Kida (1984a). Kida operationalised the specific base rate by telling subjects that 2% of the firms in the selected industry failed. The name of the specific industry was not given because the number of publicly listed companies in Hong

Kong was not large. Otherwise, it would be easy for the subjects to guest the real identities of those firms included in the instrument, and would lead to a potential threat to the internal validity of the current study. The pretest of the instrument used in the current study was indicated the subjects were sensitised to this treatment information.

Causality means that the base rate of financial distress could be perceived as having a cause-and-effect relationship (Ajzen, 1977; Tversky and Kahneman, 1982a; Bar-Hillel, 1983). Kida (1984a) operationalised the causal base rate for failure firms by describing the firms as having similar cash flows as failed firms. This operationalisation was not adopted in the current study because this definition would mislead the subjects to pay more attention to the liquidity of the firms. In the pilot interviews, the senior bank loan officers revealed that bank loan officers particularly related the financial distress of a firm to its industry risk. Therefore, industry risk was used as the operational definition of the causal base rate in the current study.

5.7.2 Need for Cognition

As mentioned in Section 5.5.3, the subjects' need for cognition (NC) trait was measured by the 18-item NC scale as developed by Cacioppo *et al.* (1984). Each subject's NC score was obtained by summing up the score for each statement. Since half of the statements were asked in opposite directions to enhance the reliability of the data collected (including the statements 3, 4, 5, 7, 8, 9, 12, 16 and 17), the scores of these statements needed to be multiplied by -1 before the summation.

Subjects were split at the median of their NC scores into two groups. Subjects who scored above the median were classified as high NC, whereas subjects who scored

below the median were classified as low NC (no scores equal to the median were found in the data set).

The major reasons why the subjects' NC scores were analysed primarily as a class (discrete) variable instead of a continuous variable in the current study were that the main objective of the current study was to compare the higher NC group with the lower NC group in terms of the appropriateness of their confidence, rather than the association between NC and appropriateness of confidence. In addition, the Likert scale of this rather newly developed instrument was mainly interpreted as an interval scale by previous NC studies rather than a continuous scale.

Although analysing the NC scores as a continuous variable would gain more information and increase the statistical power, it may also lead to a less reliable conclusion. Possibly partly due to this reason and the exploratory nature of the studies, most previous NC research in psychology adopted NC as a class variable for testing group means (Cacioppo and Petty, 1982; Cacioppo *et al.*; 1983; Cacioppo, Petty, Kao and Rodriguez; 1986; Ahlering, 1987; Haugtvedt *et al.*; 1988; Ahlering and Parker, 1989; Haugtvedt and Petty, 1989; D'agostino and Fincher-kiefer; 1992; Verplanken *et al.*, 1992). A similar approach was also adopted in the current study so that the findings could be compared with those previous ones.

Although NC was mainly analysed as a class variable in the current study, supplementary tests taking NC as a continuous variable were also conducted to provide additional insights into the findings (see Section 6.5.3 of Chapter VI). It was found that the effect of NC on appropriateness of confidence was improved when NC was treated as a continuous variable, but this effect was still unable to reach a significant level. Therefore, whether treating NC as a class or a continuous variable did not affect the conclusions on the hypotheses related to this variable.

5.7.3 Perceived Informativeness of Case-Specific Evidence

The perceived informativeness of case-specific evidence is considered to be a different construct from task predictability. To investigate the differences between these two terms, it is necessary to refer to their definitions and measurements. For example, Casey and Selling (1986) defined task predictability as the ability of the financial ratio cues used to predict the financial distress of a firm by a statistical prediction model. This definition of task predictability was also adopted by later accounting studies in a similar research context (Selling, 1993; Mladenovic and Simnett, 1994; Simnett, 1994).

Also, Casey and Selling (1986) measured task predictability by using an iterative computer-based algorithm to identify 30 firms (15 bankrupt and 15 non-bankrupt) from 145 firms in such a way that the difference in classification accuracy between using the financial statement information of one year and two years prior to bankruptcy was maximised. All 30 firms were accurately classified by using their financial data of one year prior to bankruptcy, whereas only 53.3% of these firms were classified correctly by using the same types of financial data but of two years prior to bankruptcy. Therefore, task predictability was measured by the prediction accuracy of a statistical prediction model using model-selected information (see Simnett and Trotman, 1989 for more discussions of model and information).

In contrast, the perceived informativeness of case-specific evidence can be defined as how informative the case-specific evidence is perceived by a judge in terms of the financial distress likelihood of a sample firm. This perceived likelihood represented a human judgment made by using human-selected information and might not necessarily have any direct relationships with the actual prediction accuracy. It was operationalised by dividing the financial distress likelihood values estimated by

subjects in Task 1 into two groups of an approximately equal number of observations. The more informative case-specific evidence group contained financial distress likelihood of more extreme values in both directions (say < 30% or > 70%), which indicated that the firms were either very likely or very unlikely to be in financial distress. In contrast, the less informative case-specific group contained financial distress likelihood around the median (say between 30% and 70%), which provided relatively little information on whether the firms would or would not be in financial distress.

Although some people may suspect that task predictability would have a confounding effect on the perceived informativeness of case-specific evidence, no study has so far been conducted to address these two constructs together. From their operational definitions, no theoretical relationships between them can be identified. Therefore, these two variables were considered to be two different constructs. However, to investigate any possible confounding effect of task predictability, additional analysis was performed in the current study to examine whether the original conclusions would be changed after controlling for the effect of task predictability. The results of this additional analysis were in line with the above discussions that task predictability and the perceived informativeness of case-specific evidence were two different constructs. These results will be described in detail in Chapter VI.

To allow more efficient grouping of observations, financial distress likelihood with a value of less than 0.5 was first converted by the following method:

Converted financial distress likelihood = 1 - financial distress likelihood

The purpose of this conversion was to ensure that all the financial distress likelihood values were in the range between 0.50 to 1.00. After this conversion, the financial distress likelihood with a value of 1.00 indicated that the firms would either certainly be in financial distress or certainly not be in financial distress, whereas a value of 0.50

represented neutral on whether the firms would or would not be in financial distress. Then the median of all these converted likelihood values was found. While likelihood values greater than or equal to the median were classified into the more informative case-specific evidence group, those likelihood values that were less than the median were classified into the less informative case-specific evidence group. This operationalisation is quite similar to that adopted by Johnson (1983) to group case-specific evidence by the perceived similarity of financial distress.

5.7.4 Appropriateness of Confidence

Appropriateness of confidence was the dependent variable of the current study. This variable was measured by comparing the subjects' probability judgments of financial distress solicited in Task 2 of the experiment with a normative standard. Since the subjects had indicated the financial distress likelihood in Task 1 of the experiment and base-rate information was also given to the subjects in Task 2, the posterior normative probabilities calculated by using the Bayesian rule could be used to determine the appropriateness of the subjects' confidence.

For example, consider the events of financial distress [D] and financial non-distress [D'] in a prediction problem in which the likelihood [P(E/D) and P(E/D')] and the base rates of the events [P(D) and P(D')] are combined to form the posterior normative probabilities of financial distress and non-distress [P(D/E) and P(D'/E)]. According to the Bayesian rule, the optimal integration of sample evidence and base-rate information is given by

$$\frac{P(D/E)}{P(D'/E)} = \frac{P(E/D)}{P(E/D')} \times \frac{P(D)}{P(D')} \qquad (5.3)$$

Since the sum of the probabilities of financial distress and financial non-distress is one, the following equations can be stated as:

$$P(D') + P(D) = 1, \tag{5.4}$$

$$P(D'/E) + P(D/E) = 1, \tag{5.5}$$

and

$$P(E/D') + P(E/D) = 1. \tag{5.6}$$

Also, P(D) was given in the instrument as 0.30 (see Section 5.7.1 for the discussion of the financial distress base rate). By substituting the value of P(D) and Equations (5.4) to (5.6) into Equation (5.3) and rearranging the formula, the following equation can be obtained:

$$P(D/E) = \frac{0.30\,[P(E/D)]}{0.70 - 0.4\,[P(E/D)]}. \tag{5.7}$$

Examples of how to apply Equation (5.7) to find the posterior normative probabilities can also be found in Table 4.1 of Chapter IV. In Table 4.1, the first column was "Case-specific evidence" and was measured by the financial distress likelihood estimated by the subjects (P(E/D)) and the second column was "The normative probability" and represented the corresponding posterior normative probabilities (P(D/E)) calculated by using financial distress likelihood and Equation (5.7). For instance, if P(E/D) is substituted by 0.5 in Equation (5.7), P(D/E) will be equal to 0.3. The same result can be obtained from Table 4.1 by referring to 0.5 in the first column, and 0.3 is the corresponding normative probability in the second column.

The measurement of appropriateness of confidence for each financial distress prediction was determined by comparing the subject's estimation of each financial distress probability in Task 2 with the corresponding normative probability as being described in Equation (5.7). If the subject's subjective probabilistic judgment was

higher than the corresponding normative probability, the subject was said to be overconfident. Otherwise, the subject was said to be underconfident (i.e., if his/her subjective probabilistic judgment was lower than the corresponding normative probability).

5.8 Data Analysis Methods

A t-test was used to investigate the overall appropriateness of bank loan officers' confidence as tested in Hypothesis 1. Since a t-test is a special case of an analysis of variance (ANOVA) test, the assumptions of the ANOVA test as discussed later in this section is also applicable to the t-test.

An unbalanced ANOVA test was used as the primary tool to investigate the main effects of the three independent variables: the relevance of base-rate information, the NC trait of bank loan officers, and the perceived informativeness of case-specific evidence. This test was also used to examine the interaction effects of the first two independent variables. Although both multiple regression and ANOVA can be used to test research hypotheses, ANOVA is usually considered as being more appropriate when observations are grouped by categorical independent variables in experiments, whereas multiple regression is commonly used when the independent variables of a study are metric variables (Ivensen and Norpoth, 1987).

In conducting data analysis, the following assumptions of ANOVA had been observed carefully: normality, homogeneity of variances, and independent errors (Hays, 1969, pp. 378-379). To satisfy the normality assumption, a large number of observations for each treatment cell were used (see Sections 6.3 and 6.4 of Chapter VI for the discussion of the number of observations in each treatment cell). Hays (1969, p.239) suggested that a treatment cell size of 30 or more is considered to be

large enough for assuming the satisfaction of the normality requirement in many psychology studies (the treatment cell sizes of the current study were all over 100). Also, Keppel (1982, p.86) argued that violations of the normality assumption do not constitute a serious problem except if the violations are especially severe. Therefore, this assumption is deemed to have been satisfied in the current study.

The assumption of homogeneity of variances will not be a major problem if the treatment cell sizes are more or less equal. However, the treatment cell sizes of the current study were inevitably not equal to each other. The reason was that subjects were first randomly assigned to the two base-rate information groups, and the subjects in each base-rate information group were then divided into the high and low NC groups by the median of their NC scores. In addition, all the subjects were re-divided into the more and the less informative case-specific evidence conditions by the median of the converted distress likelihood values. These assignments of the subjects into groups would result in unequal treatment cell sizes. If a balanced ANOVA test were used in this case, the assumption of homogeneity of variances would become a serious problem and the results of the analysis might be distorted. Following the suggestion given by Keppel (1982, p.351), an unbalanced ANOVA test was used instead of a balanced ANOVA test in order to overcome this problem.

The original intention of the investigator was to assume that the independence assumption would not significantly be violated. In the current study however, each of subjects was required to make ten assessments in each task. The subjects might have "brought" certain characteristics of their own to the task. These characteristics might have a consistent effect on the ten assessments that each of them had made, and therefore the possibility of some dependence among these assessments could not totally be ruled out. For this reason, several steps had been taken in the experiment in order to mitigate the dependence among the various assessments made by the same subject. For example, the instructions of the experiment instrument emphasised the

need for the subject to make independent judgment on each corporate financial profile. In addition, each corporate financial profile was presented to the subject on a separate page. After these steps had been taken, it was considered that any remaining dependence among the observations would not substantially affect findings of the current study.

In addition, in view of the exploratory nature of the current study, the unbalanced ANOVA test, which assumes independent observations and has a stronger statistical power than other potential statistical tests, was used as the primary data analysis tool in the current study. Nonetheless, as mentioned earlier, since it was impossible to rule out completely the dependence among the observations, a supplementary analysis by using a repeated measures ANOVA test, which does not assume independence among the observations, was also performed. The results of this additional analysis were then used to compare with those of the unbalanced ANOVA test to enhance the reliability of the findings. This supplementary analysis will be discussed in detail in Section 6.5.4 of Chapter VI.

5.9 Chapter Summary

This chapter described the research method and design used for testing the research hypotheses developed. The experimental method was selected because the major goal of the current study was to test the causal relationship between the relevance of base-rate information and the appropriateness of bank loan officers' confidence, if any. A two-group experimental design with before and after treatment observations was then delineated. The process of selecting the 50 subjects was explained and the development of the experiment instrument was presented. The administration of the experiment, and the operationalisation and measurement of the concerned variables were then described in detail. Finally, the data analysis methods used and their major

assumptions were discussed. On this basis, the next chapter will proceed to analyse the data collected from the experiments.

CHAPTER VI

ANALYSIS OF DATA

6.1 Introduction

The purpose of this chapter is to present the results of analysing the data collected from the experiments. The remainder of the chapter is arranged around five sections. Section 6.2 first provides the descriptive data about the subjects: their ages, banking and lending experience, and need for cognition (NC) scores. Section 6.3 then presents the results of stepwise logit analysis for identifying the useful financial ratios to be used by the subjects for predicting the probabilities of firms being in financial distress. Section 6.4 discusses the findings on testing each hypothesis. Section 6.5 describes the results of some additional analyses on the data and compares these results with those presented in Section 6.4. Finally, Section 6.6 provides a summary of the chapter.

6.2 Descriptive Data about the Subjects

A total of 50 bank loan officers participated in the current study. As shown in Table 6.1, the subjects ranged in age from 24 to 45 years old with a mean of 33.8, a median of 36 and a standard deviation of 6.4. The banking experience of the subjects ranged from 1 year to 28 years with a mean of 11.3, a median of 10 and a standard deviation of 7.6. The lending experience of the subjects ranged from 1 year to 15 years with a mean of 6.7, a median of 6 and a standard deviation of 4.1. This descriptive data confirms that the minimum requirement of one year's lending experience for the subjects was satisfied.

Table 6.1

Descriptive Characteristics about the Subjects

	Age	Banking Experience (in years)	Lending Experience (in years)	The NC Score		
				Low NC Group	High NC Group	Overall
Mean	33.8	11.3	6.7	5.1	20.0	12.5
Standard Deviation	6.4	7.6	4.1	6.0	4.5	9.2
Range						
Maximum	45	28	15	13	32	32
Median	36	10	6	7	20	13.5
Minimum	24	1	1	-8	14	-8

Table 6.1 also shows the descriptive data about the NC scores of the subjects. The NC scale contained 18 questions, and the subjects were asked to indicate their degree of agreement or disagreement for each of these questions on a 7-point Likert scale ranged from -3 to 3, with 0 indicating indifference. Therefore, the minimum score for this scale that each subject could have was -54 (-3 x 18) and the maximum score was 54 (3 x 18) with an average of 0. The overall NC scores of the subjects in the current study ranged from -8 to 32 with a mean of 12.5, a median of 13.5 (i.e., the average of the two middle observations) and a standard deviation of 9.2. When subjects were divided into two groups by the median, the NC scores of low NC group ranged from -8 to 13 with a mean of 5.1, a median of 7 and a standard deviation of 6.0. The NC scores of high NC group ranged from 14 to 32 with a mean of 20, a median of 20 and a standard deviation of 4.5.

A t-test was also performed to investigate whether the overall mean NC score of the subjects was significantly different from 0. With a t-value of 9.66 and a p-value of less than 0.0001, it suggested that the mean NC score of the subjects was significantly different from 0. Since the mean NC score of the subjects was much larger than zero, on average the subjects seemed to have a relatively high tendency to engage in and enjoy expending cognitive effort to do this prediction task.

In order to ensure the reliability of the NC scale being used in the current study, the Cronbach's alpha coefficient was calculated. This coefficient is an indicator for determining the reliability of a multi-item question based on the average correlation among items within the question (Nunnully, 1978, p. 210). The value of this coefficient for the current study was found to be 0.6481. Although the coefficient of this value was lower than that found in the previous NC studies, Nunnully (1978, p. 226) suggested that instruments having a Cronbach's alpha coefficient of 0.60 or even 0.50 is deemed to be acceptable for basic research.

6.3 Stepwise Logit Analysis

Although stepwise logit analysis was used mainly for model development rather than for testing hypotheses in the current study, the results of this analysis were reported here for ease of reference. As mentioned earlier in Section 5.5.2.1 of Chapter V, 33 potential financial ratios were identified from the literature for further examination. Logit analysis was applied to 13 financially distressed and 26 healthy firms and was used to select the most useful financial ratios to be included in the experiment instrument. In the stepwise model-selection method, independent variables which had already been selected at the intermediate steps did not necessarily remain in the final model. These variables were entered into and removed from the model in such a

way that each forward selection step was followed by one or more backward elimination steps. This process terminated when no further variable could be added to the model. The results of stepwise logit analysis are shown in Appendix C and discussed below.

There were 14 steps involved in the stepwise selection procedure. After each variable had been introduced to or removed from the model, a table of four criteria for assessing the model fit was provided (see Appendix C). The figures under the column of "Intercept Only" indicated the extent of the model fitting the intercept only. The figures under the column of "Intercept and Covariates" showed the extent of the model fitting the intercept and explanatory variables. The figures under the last column of "Chi-Square for Covariates" gave tests for the joint significance of the independent variables in the model by means of Chi-Square test statistics. The figures in the first two columns only provided statistics primarily used for comparing different models for the same data. In general, the lower values of these two statistics suggested a better model. A summary of the stepwise procedure was provided at the end of the model-building process.

The table of "Analysis of Maximum Likelihood Estimates" provided the major estimates of the model, such as the parameter estimates. The results of this table suggested that the model contained eight explanatory variables as shown below:

- Current assets to current liabilities
- Quick assets to total assets
- Working capital to equity
- Sales to cash
- Sales to total assets
- Sales to equity
- Total debt to equity
- Total debt to total assets

The table of "Association of Predicted Probabilities and Observed Response" showed four measures of association for assessing the predictive ability of a model. They were based on the number of pairs of observations with different response values, the number of concordant pairs, and the number of discordant pairs.

Finally, a classification table indicated the prediction accuracy of the model. As shown in this table, the overall correct prediction percentage of the model was 74.4%. This percentage could further be broken down into two components: sensitivity and specificity of 53.8% and 84.6% respectively. Sensitivity was the proportion of firms in financial distress that were correctly predicted to be in financial distress. Specificity was the proportion of healthy firms that were correctly predicted to be healthy. Similarly, the overall incorrect prediction percentage of 25.6% (1 - 74.4%) could also be broken down into two parts: the false positive rate and the false negative rate, being 36.4% and 21.4% respectively. The false positive rate was the proportion of firms in financial distress that were incorrectly predicted to be healthy. The false negative rate was the proportion of healthy firms that were incorrectly predicted to be in financial distress. With a relatively high prediction accuracy, the eight extracted financial ratios (plus the one found during the pilot interviews) were deemed to be useful for predicting firms being in financial distress.

Some apparently odd financial ratios in the corporate financial profiles as shown in the experiment instrument were noted. For example, the values of total debt to total shareholders' equity and total debt to total assets were the same in both the corporate financial profiles of Company A and Company I. Also in the corporate financial profile of Company I, both of these debt ratios were zero, but the current ratio indicated that the company's current liabilities were greater than its current assets. After careful investigation, it was found that the major reason for the existence of these odd financial ratios was due to the rounding of those ratios to two decimal

places. For example, in the corporate financial profile of Company A, total debt to total shareholders' equity and total debt to total assets were 0.161710 and 0.156998 respectively. Both of them were rounded to the same value of 0.16. However, it is believed that these apparently odd ratios would not have any significant effects on the subjects' responses.

6.4 Statistical Testing for Hypotheses

Sniezek and Buckley (1993) suggested that most of the confidence research in psychology aggregated data across large numbers of subjects and judgment items to obtain sufficient data for performing statistical analysis. Accounting researchers also adopted this approach for undertaking this type of research (such as Johnson, 1983). However, this approach has been recognised as having its own limitations. May (1986) argued that aggregating across heterogeneous items may contaminate the results by different item characteristics, such as task predictability (Casey and Selling, 1986; Selling, 1993; Mladenovic and Simnett, 1994). With a similar argument, Sniezek and Buckley also pointed out that aggregating data across people may mask the effects of their individual differences on the outcomes.

The current study also adopted this approach because it was commonly used among researchers of both accounting and psychology and its potential threats as discussed above did not seem to be a major concern to this research. For example, in the current study, subjects in the two base-rate information groups and the two NC groups were given the same set of corporate financial profiles. The existence of heterogeneous profiles was expected to affect both groups of subjects to a similar extent. Therefore, the problem associated with heterogeneous items did not seem to apply to these two variables. In addition, since these subjects were randomly assigned to the two base-rate information groups, the effects of some basic individual

difference factors of the subjects on their performance in these two groups were expected to be similar. Therefore, aggregating data across subjects also did not seem to cause any problem to this variable. However, the perceived informativeness of case-specific evidence was one important item characteristic investigated in the current study; the effects of heterogeneous items and individual differences on this variable cannot be totally eliminated.

Under this approach, each individual prediction by a subject was taken as being an independent observation. Since each subject made ten individual assessments of the financial distress probability for the ten given corporate financial profiles, the total number of 500 observations were obtained by summing up all data across the 50 subjects and ten corporate financial profiles for each subject (50 x 10 = 500). As mentioned in Section 5.8 of Chapter V, the major limitation of this approach is that the ten assessments made by each subject would not completely independent. For this reason, additional analysis by using repeated measures ANOVA was also performed and the results of this analysis will be discussed in detail later in Section 6.5.4.

6.4.1 Testing Hypothesis 1

The purpose of testing Hypothesis 1 is to investigate whether bank loan officers tend to have inappropriate confidence. The null hypothesis suggests that bank loan officers do not tend to have overconfidence when predicting the probabilities of firms being in financial distress. The alternative hypothesis states that bank loan officers tend to have overconfidence when predicting the probabilities of firms being in financial distress. This hypothesis was tested by a t-test with a purpose to investigate whether the mean appropriateness of bank loan officers' confidence was significantly different from zero.

The result of the t-test as shown in Table 6.2 indicated that the t-statistic was 22.62 and was found to be highly significant with a p-value less than 0.0001. This suggested that bank loan officers had inappropriate confidence. The type of inappropriate confidence was further examined by referring to the direction of the mean appropriateness of confidence. Since the mean appropriateness of confidence was 12.50% and a positive value of it indicated that bank loan officers tended to have overconfidence, the null hypothesis was rejected and the alternative hypothesis was supported accordingly.

Table 6.2

t-test for Appropriateness of Confidence

Mean	Standard Deviation	t-value	p-value
0.1250	0.1235	22.62	0.0001

6.4.2 Unbalanced ANOVA Model

A model is used for delineating the relationships of the dependent variable and the three independent variables examined in the current study. This model is given in Equation (6.1) as follows:

$$AC = BR + NC + BR * NC + CS + \varepsilon. \qquad (6.1)$$

where

AC = Appropriateness of confidence,

BR = The relevance of base-rate information,

NC = The NC trait of bank loan officers,

CS = The perceived informativeness of case-specific evidence, and

ε = The error term of the model.

Testing the first four terms of the above model corresponds to testing Hypotheses 2 to 5. As discussed previously in Chapter V, unequal treatment cell sizes would result from grouping the bank loan officers' NC trait and the perceived informativeness of case-specific evidence after the experiments were conducted. The numbers of observations in the cells being constructed from the combinations of the independent variables specified in the model are given in Tables 6.3 and 6.4. As shown in Table 6.3, the number of observations for high NC bank loan officers was found to be larger than that of low NC bank loan officers in the more relevant base-rate information group. Conversely, there were more observations for high NC subjects than for low NC subjects in the less relevant base-rate information group. Similarly, as shown in Table 6.4, more observations were classified in the more informative case-specific evidence condition than in the less informative case-specific evidence condition.

Table 6.3

Distribution of the Numbers of Observations for the Relevance of Base-Rate Information and Need for Cognition

Relevance of Base-Rate Information	Need for Cognition		Total
	High	Low	
More Relevant	140	110	250
Less Relevant	110	140	250
Total	250	250	500

Table 6.4

Distribution of the Numbers of Observations for the Perceived Informativeness of Case-Specific Evidence

Perceived Informativeness of Case-Specific Evidence	Total
More Informative	286
Less Informative	214
Total	500

As discussed previously in Section 5.8 of Chapter V, unequal treatment cell sizes will lead to biases if an ANOVA test is used without any adjustment. Therefore, the model shown in Equation (6.1) was instead tested by an unbalanced ANOVA test. The results of this test were used to investigate Hypotheses 2 to 5 and will be

discussed in more detail later in Sections 6.4.4 to 6.4.7. The next section will first present the results of testing the assumption that subjects were not pre-occupied with a certain base rate other than an even-odd base rate (i.e., a base rate of 0.5).

6.4.3 Testing the Base Rate Pre-occupied by the Subjects

One possible competing explanation for any results of testing Hypotheses 2 to 5 is that subjects were pre-occupied with a certain financial distress base rate other than an even-odd one when they estimated the financial distress likelihood in Task 1 of the experiments. If the subjects did use such a base rate, their adjustments to the financial distress likelihood in Task 2 will be different from the adjustments if they used an even-odd base rate. Therefore, the first task before examining the results of the unbalanced ANOVA is to test whether this possible competing explanation can be established.

Three possible ways can be used to perform this test. The first method is to run a t-test for comparing the ratio of the percentage of financial distress predictions to the percentage of financial non-distress predictions with one. The second method is to run a t-test to compare the percentage of financial distress predictions (or financial non-distress predictions) with 0.5. The third method is to use a matched pair t-test to compare the percentage of financial distress predictions with the percentage of financial non-distress predictions for each subject, and to investigate whether they are significantly different from each other. Significant results obtained from any one of these tests would indicate that the possible competing explanation could not be rejected.

However, the first method could not be used to test this possible competing explanation because some individual subjects had a zero percent in at least one of the

either financial distress or financial non-distress predictions, leading to a value of infinity. Therefore, only the second and the third methods were used to examine this issue. The results of these two tests are shown in Tables 6.5 and 6.6.

Table 6.5

t-Test to Compare the Percentage of Financial Distress Predictions with 0.5

Number of Observations	Mean	Standard Deviation	t-value	p-value
50	-0.0492	0.2434	-1.4283	0.1595

Table 6.6

Matched Pair t-Test to Compare the Percentage of Financial Distress Predictions with the Percentage of Financial Non-Distress Predictions

Number of Observations	Mean	Standard Deviation	t-value	p-value
50	-0.0983	0.0688	-1.4283	0.1595

The result of the matched pair t-test as shown in Table 6.5 suggested that the percentage of financial distress predictions was not significantly different from the percentage of financial non-distress predictions. The t-test as shown in Table 6.6 also revealed that the percentage of financial distress predictions was not significantly different from 0.5. Therefore, both tests drew exactly the same conclusion with the same p-value of 0.1595 that the subjects were not pre-occupied with a certain base rate other than an even-odd one when estimating the financial distress likelihood in

Task 1 of the experiment. The results of these tests should lend much comfort to the results of testing Hypotheses 2 to 5 as presented in the next several sections.

6.4.4 Testing Hypothesis 2

The purpose of testing Hypothesis 2 is to investigate the main effect of the relevance of base-rate information on the appropriateness of bank loan officers' confidence. The null hypothesis suggests that bank loan officers who are given the more relevant base-rate information do not tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do those who are given the less relevant base-rate information. The alternative hypothesis states that bank loan officers who are given the more relevant base-rate information tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do those who are given the less relevant base-rate information.

This hypothesis was tested by examining the first term of the unbalanced ANOVA model as shown in Equation (6.1). The result of testing this hypothesis is shown in the first row of Table 6.7. This indicated that the relevance of base-rate information was found to be statistically significant with a p-value of 0.0273. Table 6.8 further shows the means (and standard deviations) of the appropriateness of confidence for the two base-rate information groups, with the means of the more and the less relevant base-rate information groups being 11.28% and 13.72% respectively. These results indicated that although both groups were found to be overconfident, on average the subjects in the less relevant base-rate information group were significantly more overconfident than those in the more relevant base-rate information group. Therefore, the null hypothesis was rejected and the alternative hypothesis was supported accordingly.

6.4.5 Testing Hypothesis 3

The testing of this hypothesis attempts to examine the main effect of the bank loan officers' NC trait on the appropriateness of their confidence. The null hypothesis suggests that high NC bank loan officers do not tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers. The alternative hypothesis states that high NC bank loan officers tend to have less overconfidence than do low NC bank loan officers.

Table 6.7

Unbalanced Analysis of Variance

Source	df	Mean Square	F-value	p-value
Relevance of Base-Rate Information (BR)	1	0.0659	4.90	0.0273*
Need for Cognition (NC)	1	0.0048	0.36	0.5496
BR x NC	1	0.0102	0.76	0.3830
Perceived Informativeness of Case-Specific Evidence (CS)	1	0.8622	64.15	0.0001**
Error	495	0.0134		
Total	499			
R-Square	0.1264			

* $p < 0.05$

** $p < 0.001$

Table 6.8

Means of Appropriateness of Confidence in Unbalanced ANOVA: the Relevance of Base-Rate Information

Relevance of Base-Rate Information	Means of Appropriateness of Confidence
More Relevant	0.1128 (s.d. = 0.1018)
Less Relevant	0.1372 (s.d. = 0.1411)

The result of testing this hypothesis is shown in the second row of Table 6.7. This indicated that the bank loan officers' NC trait was found to be statistically insignificant with a p-value of 0.5496. Table 6.9 further shows the means (and standard deviations) of the appropriateness of confidence for both NC groups, with the means of high and low NC groups being 12.37% and 12.63% respectively. These indicated that although both groups were overconfident, on average the subjects in low NC group were found to be more overconfident than those in high NC group. However, the extent of overconfidence of the two NC groups did not differ significantly from each other. Therefore, the null hypothesis could not be rejected and the alternative hypothesis was not supported.

Table 6.9

Means of Appropriateness of Confidence in Unbalanced ANOVA: Need for Cognition

Need for Cognition	Means of Appropriateness of Confidence
High	0.1237 (s.d. = 0.1006)
Low	0.1263 (s.d. = 0.1430)

6.4.6 Testing Hypothesis 4

The purpose of testing this hypothesis is to investigate the moderating effect of the bank loan officers' NC trait on the relationship between the relevance of base-rate information and appropriateness of confidence. The null hypothesis suggests that high NC bank loan officers do not tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers, no matter whether they are given the more or the less relevant base-rate information. The alternative hypothesis states that high NC bank loan officers tend to have less overconfidence than do low NC bank loan officers when they are given the less relevant base-rate information. Conversely, high NC bank loan officers do not tend to have less overconfidence than do low NC bank loan officers when they are given the more relevant base-rate information.

The result of testing this hypothesis is shown in the third row of Table 6.7. This indicated that the interaction of the relevance of base-rate information and the bank loan officers' NC trait was found to be statistically insignificant with a p-value of

0.3830. Table 6.10 further shows the means (and standard deviations) of the appropriateness of confidence for the cells formed by the combinations of the two NC groups and the two base-rate information groups, with the means of high and low NC groups when they were given the less relevant base-rate information being 14.55% and 13.06% respectively. However, the order of these means for subjects in high and low NC groups was reversed when they were given the more relevant base-rate information, that is, 10.65% and 12.07% respectively.

Table 6.10

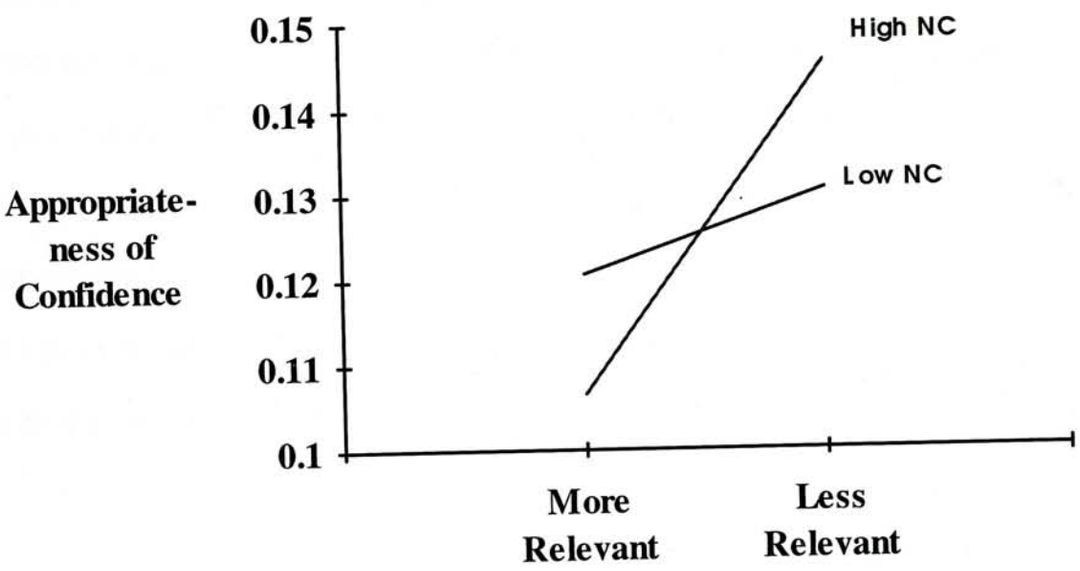
Means of Appropriateness of Confidence in Unbalanced ANOVA: The Interaction of the Relevance of Base-Rate Information and Need for Cognition

Relevance of Base-Rate Information	Need for Cognition	
	High	Low
More Relevant	0.1065 (s.d. = 0.1058)	0.1207 (s.d. = 0.0965)
Less Relevant	0.1455 (s.d. = 0.0895)	0.1306 (s.d. = 0.1712)

Figure 6.1 plotted these results on a line chart and indicated the existence of interaction effects between these two variables. It showed that although subjects in all cells were overconfident, high NC subjects were more overconfident than low NC ones when they were given the less relevant base-rate information, whereas high NC subjects were less overconfident than low NC ones when they were given the more relevant base-rate information. Surprisingly, the directions of these interaction

effects were opposite to those predicted by the alternative hypothesis. In conclusion, the null hypothesis could not be rejected and the alternative hypothesis was not supported.

Figure 6.1
Means of Appropriateness of Confidence: The Relevance of Base-Rate Information by Need for Cognition



6.4.7 Testing Hypothesis 5

The purpose of testing this exploratory hypothesis is to investigate the main effect of the perceived informativeness of case-specific evidence on the appropriateness of bank loan officers' confidence. The null hypothesis suggests that bank loan officers who perceive case-specific evidence as being more informative do not tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do those who perceive case-specific evidence as being less informative. The alternative hypothesis states that bank loan officers who perceive case-specific

evidence as being more informative tend to have less overconfidence than do those who perceive case-specific evidence as being less informative.

The result of testing this hypothesis is shown in the fourth row of Table 6.7. This indicated that the perceived informativeness of case-specific evidence was found to be statistically highly significant with a p-value of 0.0001. Table 6.11 further shows the means (and standard deviations) of the appropriateness of confidence for both the case-specific evidence groups, with the means of the more and the less informative case-specific evidence groups being 8.86% and 17.36% respectively. These indicated that although both groups were overconfident, on average the subjects in the more informative group were found to have less overconfidence than those in the less informative group. Therefore, the null hypothesis was rejected and the alternative hypothesis was supported accordingly.

Table 6.11

Means of Appropriateness of Confidence in Unbalanced ANOVA: the Perceived Informativeness of Case-Specific Evidence

Perceived Informativeness of Case-Specific Evidence	Mean of Appropriateness of Confidence
More Informative	0.0886 (s.d. = 0.1205)
Less Informative	0.1736 (s.d. = 0.1103)

6.5 Supplementary Statistical Testing of Hypotheses

6.5.1 Separate Models for Hypotheses 2 to 5

As mentioned in Section 6.4, Hypotheses 2 to 5 were tested by a single unbalance ANOVA model as shown in Equation (6.1). The perceived informativeness of case-specific evidence could not be manipulated in the experiments but was measured instead by the subjects' self-perception. In order not to confound the other findings in the model because of any possible measurement biases, it is desirable to run additional tests on the hypothesised relationship between this variable and appropriateness of confidence as depicted in Hypothesis 5 in a separate sub-model as shown below in Equation (6.2). Hypotheses 2 to 4 are then tested in the other sub-model as shown in Equation (6.3).

$$AC = CS + \varepsilon. \tag{6.2}$$

$$AC = BR + NC + BR * NC + \varepsilon. \tag{6.3}$$

The results of testing Hypotheses 2 to 5 by using these two separate sub-models were found to be the same as those reported in Section 6.4. Therefore, it can be concluded that the results for Hypotheses 2 to 5 were not sensitive to the use of different unbalanced ANOVA models.

6.5.2 Effects of Other Interactions

Although the two two-way interactions between the relevance of base-rate information and the perceived informativeness of case-specific evidence (BR x CS) and between the NC trait and the perceived informativeness of case-specific evidence

(NC x CS), and the three-way interaction of all the independent variables (BR x NC x CS) have not been hypothesised in the current study due to a lack of theoretical support for these interactions, the tests of these unhypothesised interactions were also run as additional exploration in order to detect any potential significant interactions. The testing of these interaction effects can be investigated by the full unbalanced ANOVA model that incorporates all the possible combinations of the independent variables examined in the current study. This model is shown below in Equation (6.4):

$$AC = BR + NC + CS + BR * NC + BR * CS + NC * CS + BR * NC * CS + \varepsilon. \quad (6.4)$$

As expected, the interactions that have not been hypothesised and investigated in the current study were found to be statistically insignificant. The results of testing Hypotheses 2 to 5 by the above model were also found to be the same as those reported in Section 6.4. Again, these results further supported the premise that the findings on testing Hypotheses 2 to 5 were not sensitive to the use of different unbalanced ANOVA models.

6.5.3 Analysing NC As a Continuous Variable

As mentioned previously in Section 5.7.3 of Chapter V, although NC was mainly analysed as a class (discrete) variable in the current study in order to meet its primary objective of comparing high NC group with low NC group in terms of appropriateness of confidence, a supplementary unbalanced ANOVA test assuming the NC scores as a continuous variable was also conducted to gain additional insights into the findings. It was found that the effect of NC on appropriateness of confidence was improved but it was still unable to reach a significant level. Therefore, whether

treating NC as a class or a continuous variable did not affect the conclusions drawn on the hypotheses related to this variable.

6.5.4 Repeated Measures ANOVA

As mentioned previously in Section 5.8 of Chapter V, all steps were taken to ensure the independence among different judgmental responses given by each subject. However, it was possible that the ten assessments made by each subject would not be completely independent. For this reason, an additional supplementary analysis of repeated measures ANOVA with both the relevance of base-rate information and the bank loan officers' NC trait as the between-subjects variables, was performed to investigate the sensitivity of the unbalanced ANOVA results to the independence assumption. The results of this analysis as shown in Table 6.12 indicated that both the direct and the moderating effects of the bank loan officers' NC trait were statistically insignificant, with p-values of 0.9828 and 0.3790 respectively. These results were similar to those of the unbalanced ANOVA related to these effects as discussed early in Sections 6.4.5 and 6.4.6. Therefore, this analysis provided further support for the original conclusions drawn on Hypotheses 3 and 4.

The result of testing Hypothesis 2 by the repeated measures ANOVA is shown in the first row of Table 6.12. Although the subjects in the less relevant base-rate information group were more overconfident than those in the more relevant base-rate information group, the result of this analysis indicated that the difference in the extent of overconfidence between the two relevant base-rate information groups was statistically insignificant at the confidence level of 0.05, with a p-value of 0.1413.

Table 6.12

Repeated Measures Analysis of Variance: Test for the Between-Subjects Effects of the Relevance of Base-Rate Information and Need for Cognition

Source	df	Mean Square	F-value	p-value
Relevance of Base-Rate Information (BR)	1	0.0736	2.24	0.1413
Need for Cognition (NC)	1	0.0000	0.00	0.9828
BR * NC	1	0.0259	0.79	0.3790
Error	46	0.0329		
Total	49			

In summary, when comparing the results of this repeated measures ANOVA with those of the unbalanced ANOVA, it was found that the conclusions on Hypotheses 3 and 4 by these two analyses were exactly the same. Some differences were, however, found in the conclusion on Hypothesis 2. The results of the unbalanced ANOVA supported Hypothesis 2 in its alternative form, while those of the repeated measures ANOVA did not, though the direction of these results was the same. In view of the different results obtained from the two analyses, the conclusions drawn on this hypothesis by the unbalanced ANOVA as described in Section 6.4.4 should be interpreted with caution. The implications of this difference will further be discussed in Chapter VII.

6.5.5 Additional Analysis — Controlling for Task Predictability

Since task predictability has been supported in the literature as one robust factor affecting appropriateness of confidence, neglecting this factor may reduce the explanatory power of the models, and may confound the effects of the other variables investigated in the current study. For example, if the effects of some significant variables found in the current study disappeared after controlling for the effect of the differences in task predictability, the conclusions drawn on those significant variables would thus be premature. For this reason, controlling for task predictability can provide a more clear picture on the effects of these other variables.

The major problem of controlling for task predictability is to find an objective proxy for this variable. Following the definition and operationalisation of task predictability as adopted by Casey and Selling (1986) which was discussed in Section 5.7.3 of Chapter V, the current study used the task predictability score as the proxy for this variable. The task predictability score is defined as the absolute difference between the probability of financial distress predicted by the logit model and the actual probability of financial distress for a corporate financial profile. If the logit model can accurately predict the actual probability of financial distress for a particular corporate financial profile, then the probability of financial distress predicted by the model will be very close to the actual probability of financial distress of the profile, and its task predictability score will be close to zero. Such a profile can then be classified as having high task predictability. Conversely, if the logit model cannot accurately predict the actual probability of financial distress for a corporate financial profile, then the probability of financial distress predicted by the model will deviate from the actual probability of financial distress of the profile, and its task predictability score will be larger than zero. In this case, that profile is classified as having low task predictability. The task predictability scores for the ten given corporate financial profiles are shown in the last column of Table 6.13 below.

Table 6.13

Task Predictability Scores for the Corporate Financial Profiles

Corporate financial profile of company	Probability of financial distress predicted by the logit model (a)	Actual probability of financial distress (b)	Task predictability Score (absolute value of (a-b))
A	0.0000	0	0.0000
B	1.0000	1	0.0000
C	0.0038	0	0.0038
D	0.0000	0	0.0000
E	0.8838	1	0.1162
F	0.0008	0	0.0008
G	0.5339	0	0.5339
H	0.5335	1	0.4665
I	0.2029	0	0.2029
J	0.0995	0	0.0995

The major advantage of this proxy is that it is a continuous variable and the task predictability score for each corporate financial profile can be calculated individually. Therefore, the statistical power of testing a model involving task predictability by using this proxy is stronger than if this variable is measured as a class variable. However, unlike those used in the literature which manipulated the variable in the experiments, the proxy used in the current study classifies task predictability of the given corporate financial profiles after the experiments were conducted. This

approach may lead to confounding effects on the other independent variables. For this reason, additional analysis related to the interaction effect of this proxy and the perceived informativeness of case-specific evidence, the other major independent variable, was also conducted.

To retest the effects of the original variables examined in the current study after controlling for the effect of task predictability, an unbalanced ANOVA is again used by including the variable of task predictability in the model. A repeated measures ANOVA is not used for examining this issue because the corporate financial profile is a repeated measures factor and the proxy for task predictability in the current study varies only among the given profiles. The new model which includes the variable of task predictability is shown in Equation (6.5) below:

$$AC = BR + NC + CS + TP + BR * NC + \varepsilon. \qquad (6.5)$$

where

AC = Appropriateness of confidence,

BR = The relevance of base-rate information,

NC = The NC trait of bank loan officers,

CS = The perceived informativeness of case-specific evidence,

TP = The task predictability of corporate financial profiles, and

ε = The error term of the model.

The results of testing this new model are shown in Table 6.14 and indicated that task predictability was a significant variable affecting the appropriateness of bank loan officers' confidence, with a p-value of 0.0329. The positive coefficient of the task predictability variable (not shown in the table) suggested that subjects given corporate financial profiles with high task predictability had more appropriate

confidence. This positive finding on task predictability in the current study was consistent with the extant literature that task predictability had a significantly positive effect on appropriateness of confidence (Lichtenstein *et al.*, 1982; Wright, 1982; Casey and Selling, 1986; Ronis and Yates, 1987; Sniezek *et al.*, 1990; Keren, 1991; Selling, 1993; Simnett, 1994).

Table 6.14

Unbalanced ANOVA: Test for the Effects of the Relevance of Base-Rate Information, Need for Cognition, the Perceived Informativeness of Case-Specific Evidence, and Task Predictability

Source	df	Mean Square	F-value	p-value
Relevance of Base-Rate Information (BR)	1	0.0659	4.94	0.0267
Need for Cognition (NC)	1	0.0048	0.36	0.5503
Perceived Informativeness of Case-Specific Evidence (CS)	1	0.8524	63.88	0.0001
Task Predictability (TP)	1	0.0611	4.58	0.0329
BR * NC	1	0.0103	0.77	0.3797
Error	494	0.0133		
Total	499			
R-square	0.1344			

Given that task predictability is a significant variable, it is therefore important to reexamine Hypotheses 2 to 5 under this new model. The results are also shown in Table 6.14 and indicated that the relevance of base-rate information and the perceived informativeness of case-specific evidence were statistically significant with p-values of 0.0267 and 0.0001 respectively. These were consistent with the original conclusions on testing Hypotheses 2 and 5 without controlling for the effect of task predictability with similar p-values (refer to the first and the fourth rows of Table 6.7 for comparisons). In addition, the results indicated that NC and the interaction of NC and the relevance of base-rate information were found to be statistically insignificant with p-values of 0.5503 and 0.3797 respectively, which were also consistent with the original conclusions on testing Hypotheses 3 and 4 (refer to the second and the third rows of Table 6.7). In summary, the conclusions on testing Hypotheses 2 to 5 in Sections 6.4.4 to 6.4.7 were not affected by controlling for the effect of task predictability[6].

6.6 Chapter Summary

This chapter first presented the descriptive data about the subjects: their average age, banking and lending experience, and NC scores. In addition, the Cronbach's alpha coefficient of the NC scale was found to be acceptable. On the basis of the results of stepwise logit analysis, eight financial ratios were selected and the model was found to have an overall classification accuracy of 74.4%.

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[6] The interaction effect of task predictability and the perceived informativeness of case-specific evidence on appropriateness of confidence was also examined. The result indicated that the interaction was statistically insignificant, with a p-value of 0.3634. This result further confirmed that the findings on the significant effect of the perceived informativeness of case-specific evidence were not confounded with the effect of task predictability.

In testing the five research hypotheses, Hypothesis 1 was tested by a t-test. Since the numbers of observations in the cells for the different combinations of the various independent variables were unequal, an unbalanced ANOVA test was therefore first used for testing Hypotheses 2 to 5. The results of these tests indicated that the alternative hypotheses for Hypotheses 1, 2 and 5 were supported. However, the null hypotheses for Hypotheses 3 and 4 could not be rejected.

Additional supplementary analyses were also performed to investigate whether the conclusions on testing Hypotheses 2 to 5 were sensitive to different ANOVA models, treating NC as a continuous variable, different independence assumption, and controlling for the effect of task predictability. In general, except Hypothesis 2, these supplementary analyses provided further support for the results of the unbalanced ANOVA. On the basis of these results, the next chapter will discuss these findings and their implications.

CHAPTER VII

SUMMARY, DISCUSSIONS AND IMPLICATIONS

7.1 Recap of the Study

The objectives of the current study are: (1) to investigate whether bank loan officers tend to have appropriate confidence when predicting the probabilities of firms being in financial distress, and (2) to examine the effects of some selected major factors on the appropriateness of bank loan officers' confidence in this specific prediction task.

Chapter II presented a detailed literature review on behavioural decision theory (BDT) in psychology which examines how individuals make decisions in general. The studies reviewed were classified into one principle and three research frameworks: the Bounded Rationality Principle; and the Lens Model, Heuristics-and-Biases, and Contingent Decision Behaviour frameworks.

Since decision-making is an important topic for a variety of disciplines, BDT is highly interdisciplinary and has attracted much research effort from accounting researchers. Behavioural decision research (BDR) in accounting represents the accounting research being developed on the basis of BDT. Chapter III reviewed the literature of BDR in accounting that adopted the Heuristics-and-Biases framework and the literature of BDR in accounting which examined the financial distress predictions made by bank loan officers.

From the literature review described in Chapters II and III, four research opportunities were identified. These research opportunities were related to the decision behaviour of bank loan officers when predicting the probabilities of firms being in financial distress. This review also indicated that very few previous studies

in accounting used appropriateness of confidence as a measure to examine the judgmental performance of real experts in accounting tasks. Specifically, no study was found to examine the appropriateness of bank loan officers' confidence when predicting the probabilities of firms being in financial distress. In addition, the research on identifying the major factors affecting the performance of probabilistic judgments was found to be still in its infancy in both psychology and accounting. Therefore, one main goal of the current study is to provide a further linking between the theories developed in BDT and BDR in accounting.

Chapter IV presented the research model developed in the light of the four research opportunities identified in previous chapters. In the model, the appropriateness of bank loan officers' confidence was treated as a dependent variable, and the relevance of base-rate information, the bank loan officers' NC trait, and the perceived informativeness of case-specific evidence were identified as independent variables. Five research hypotheses were proposed to test the specific relationships as depicted in the model and the underlying logic of these hypotheses was explained. These hypotheses in their alternative forms are summarised below:

H1: Bank loan officers tend to have overconfidence when predicting the probabilities of firms being in financial distress.

H2: Bank loan officers who are given the more relevant base-rate information tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do those who are given the less relevant base-rate information.

H3: High NC bank loan officers tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers.

H4: High NC bank loan officers tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers when they are given the less relevant base-rate information. Conversely, high NC bank loan officers do not tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do low NC bank loan officers when they are given the more relevant base-rate information.

H5: Bank loan officers who perceive case-specific evidence as being more informative tend to have less overconfidence when predicting the probabilities of firms being in financial distress than do those who perceive case-specific evidence as being less informative.

Specifically, Hypothesis 1 focused on investigating whether bank loan officers tend to have overconfidence when predicting the probabilities of firms being in financial distress. Hypotheses 2, 3 and 5 were related to the testing of the main effects of the relevance of base-rate information, the bank loan officers' NC trait, and the perceived informativeness of case-specific evidence respectively on the appropriateness of bank loan officers' confidence. Hypothesis 4 addressed the moderating effect of the bank loan officers' NC trait on the relation between the relevance of base-rate information and the appropriateness of their confidence.

Chapter V then described the research method and design of the current study. The experimental approach was adopted for testing the stated research hypotheses. Fifty bank loan officers from the Bank of China Group were enlisted on the basis of recommendations from their management and the willingness of the subjects to

participate in this research. Personal interviews were conduced individually at the subjects' offices to collect the data for testing the research hypotheses. The data collected was primarily analysed by using a t-test and an unbalanced ANOVA test in Chapter VI, supplemented by other additional tests. The results of these analyses indicated that Hypotheses 1 and 5 were strongly supported and Hypothesis 2 was only weakly supported, whereas Hypotheses 3 and 4 were not supported at all.

The main purpose of this chapter is to discuss the conclusions drawn from the results of data analyses as being presented in Chapter VI, and the implications of these conclusions. The remainder of this chapter is organised around five sections. Section 7.2 first provides the conclusion for each hypothesis and an overall conclusion for the current study. Sections 7.3 and 7.4 then discuss the implications of these conclusions for theory and practice respectively. Section 7.5 further identifies the potential limitations of the current study in order to minimise misinterpretations of these conclusions. Finally, Section 7.6 suggests some directions for further research.

7.2 Conclusions and Discussions

7.2.1 Hypothesis 1

The results of testing this hypothesis indicated that bank loan officers were found to have overall significant overconfidence of 12.50%. This implies that the probabilities of firms being in financial distress predicted by bank loan officers were significantly higher than the calculated normative probabilities. Therefore, one can conclude that bank loan officers tend to have significant overconfidence when predicting the probabilities of firms being in financial distress.

This finding is consistent with the results of the two previous accounting studies in the U.S. that investigated appropriateness of confidence in the context of predicting the probabilities of firms being in financial distress. Casey and Selling (1986) asked a group of students, as surrogates for bank loan officers, to predict the probabilities of firms being in financial distress and found that their subjects were overconfident. Similarly, Selling (1993) asked another group of students to perform the same task and further supported this result. Since the current study used real bank loan officers as subjects and individual interviews were conducted at their offices, the findings of the current study would therefore have much higher validity and reliability for generalising the results to other bank loan officers.

This finding is also consistent with the findings of overconfidence among certain types of experts, including medical doctors (Christensen-Szalanski and Bushyhead, 1981; Christensen-Szalanski, *et al.,* 1983), clinical psychologists (Oskamp, 1962; 1965), psychology graduate students responding to questions about psychological propositions (Lichtenstein and Fischhoff, 1977), and bankers when predicting stock market movements (Stael von Holstein, 1972). Moreover, this finding is consistent with the extant literature in psychology showing that people tend to be overconfident in making probabilistic judgments (Lichtenstein and Fischhoff, 1977; Lichtenstein, *et al.*, 1982; Sniezek, 1990; Yates, 1990). Particularly relevant to the current study is the literature in psychology suggesting that people tend to have overconfidence when making probabilistic judgments for events with low base rates (Dunning, *et al.*, 1990; Vallone, *et al.*, 1990; Griffin and Tversky, 1992).

This finding, however, is not in line with the findings of appropriate confidence among the three other types of expert judges: auditors (Tomassini *et al.*, 1982; Solomon *et al.*, 1985; Dilla *et al.*, 1991; Mladenovic and Simnett, 1994; Simnett, 1994), weather reporters (Murphy and Brown, 1984) and economists (Braun and

Yaniv, 1992). One major reason suggested to account for the appropriate confidence among these types of expert judges is the instant feedback they receive in the continuous judgment process. In contrast, the feedback from lending decisions received by bank loan officers is usually incomplete and not timely. For instance, the subsequent financial conditions of rejected loan applicants are usually not available to bank loan officers for further evaluation (Einhorn and Hogarth, 1978). Even though this information is available, bank loan officers may not give it the same attention as they would to those firms to which loans have been granted (Selling, 1993).

In addition, the decision of whether a loan is granted may have a significant impact on the financial and operational success of a firm. Those who are granted loans will have more chance to pursue their profitable objectives (Einhorn and Hogarth, 1978; Einhorn, 1980; Selling 1993). Therefore, the results of imbalance of attention and the financial effect of the loans granted on the borrowers' success, may lead bank loan officers to believe that they have made the right judgments in granting the loans to good clients. This inflated impression resulting from directing bank loan officers' attention only to their correct judgments may reinforce their confidence further. Additional explanations for the bank loan officers' overconfidence will be provided in the following sections.

7.2.2 Hypothesis 2

Mixed results were obtained on testing this hypothesis. On the one hand, the result of the unbalanced ANOVA test showed a support for this hypothesis. On the other, the result of the repeated measures ANOVA did not provide support for it, although the analyses indicated the same direction as hypothesised. Therefore, the current study provided only weak support for this hypothesis. On the basis of the result obtained from the unbalanced ANOVA test, one would conclude that although bank

loan officers are overconfident, those who are given the more relevant base-rate information would have less overconfidence than those who are given the less relevant base-rate information. However, this conclusion should not be strongly made in view of the different results from the two analyses.

This conclusion implies that bank loan officers would be more likely to integrate the given base-rate information in the probabilistic judgments when they perceive this information as being more relevant to the prediction task than when they perceive it as being less relevant. This conclusion is consistent with the findings of Kida's (1984a) study in a different task context and with a different type of subjects. Kida investigated the effect of the relevance of base-rate information on auditors' going-concern judgments. The results of Kida's study supported the notion that the relevance of base-rate information significantly affected auditors' judgments. Since the results of supporting this hypothesis in the current study were similar to those of Kida's, the theory on the relevance of base-rate information, though only weakly supported, can be strengthened and the ability to generalise this theory to other types of tasks and subjects is increased.

Finally, this conclusion is also consistent with previous studies in psychology which found that an increase in the relevance of base-rate information leaded people to more properly use the given base-rate information (Ajzen, 1977; Carroll and Siegler, 1977; Bar-Hillel, 1980a; Tversky and Kahneman, 1982a; Bar-Hillel, 1983; 1990), and that more proper use of the base-rate information when making probabilistic judgments will lead to less overconfidence (Griffin and Tversky, 1992). However, previous studies did not examine the effectiveness of such an increase in the relevance of base-rate information. Specifically, it was not clear whether an increase in the relevance of base-rate information would lead judges to have more appropriate confidence. This relationship is now weakly supported by the findings of the current study.

7.2.3 Hypothesis 3

This hypothesis was not supported by the current study. This result can lead one to conclude that the bank loan officers' NC trait does not affect the appropriateness of their confidence. Specifically, high and low NC bank loan officers would have a similar degree of overconfidence when predicting the probabilities of firms being in financial distress.

This conclusion seems to be inconsistent with the previous findings in those psychology studies examining the effects of NC on decision-making that high NC individuals were found to be more effective judges. For example, Heppner *et al.* (1983) found that high NC individuals were more active in information processing and more effective in problem-solving than low NC individuals. Studies also revealed that high NC individuals were affected more by the argument quality than the attractiveness of an endorser (Ahlering, 1987; Haugtvedt *et al.*, 1988). Furthermore, Verplanken *et al.* (1992) indicated that high NC individuals processed more information items than low NC individuals. All these studies suggested that high NC individuals should have better judgments than low NC individuals. However, the judgment tasks of all these studies were not probabilistic. Therefore, there were some reservations about generalising the findings of those previous studies in the NC literature as just discussed to other probabilistic judgment tasks.

The finding of the current study is also contradictory to the previous findings that an increase in cognitive effort promoted appropriate confidence. In theory, an increase in cognitive effort can be induced by an environment of accountability or provision of financial incentives. For example, Tetlock and Kim (1987) found that accountability reduced the overconfidence effect in a personality-prediction context by increasing

the awareness of complexities in the behaviour of others. Fischer (1982) suggested that provision of financial incentives led people to have more appropriate confidence by making them less likely to assign very large or very small probabilities. It was also supported that the degree of inappropriate confidence decreased as the amount of cognitive processing in choice increased (Peterson and Pitz, 1988; Sniezek *et al.*, 1990). Since NC is a personality trait that indicates the tendency of an individual to engage in and enjoy expending more cognitive effort (Cacioppo and Petty, 1982; Cacioppo *et al.*, 1984; Verplanken *et al.*, 1992), high NC individuals should expend more cognitive effort than low NC individuals in making judgments.

The results of the current study can be explained by those of Simonson and Nye (1992) which investigated the effects of accountability on a variety of decision errors. They found that accountability reduced the sunk cost effect in a personal finance context by directing the subjects' attention to the irrelevance of sunk costs. However, accountability did not seem to reduce those decision errors for which the correct response was not known or unlikely to be identified with more thorough information processing. Simonson and Nye found that accountability did not promote consistent preferences across different preference elicitation procedures, did not direct the subjects' attention to the small sample effect and the framing effect, and did not mitigate the base-rate fallacy and the conjunction fallacy.

Therefore, the results of Simonson and Nye's study suggested that an increase in cognitive effort does not necessarily lead to improvement in judgments. The effects of increasing cognitive effort on judgments depend on the characteristics of decision errors. Those decision errors which are caused by the subjects' inability to understand the decision rules cannot be improved simply by expending more effort. A probabilistic judgment that requires people to integrate base-rate information into the judgment is one such example. This contention was supported by both Simonson and Nye's study and the current study.

7.2.4 Hypothesis 4

This hypothesis could not be supported by the current study. This result leads one to conclude that the bank loan officers' NC trait does not moderate the relation between the relevance of base-rate information and the appropriateness of bank loan officers' confidence.

This conclusion seems to be inconsistent with the findings of a previous psychology study conducted by Ahlering and Parker (1989). They investigated the moderating effect of NC on an information processing bias — primacy bias — in an impression evaluation task. In their study, a group of students were asked to evaluate a person who was described by serially presenting various trait adjectives. The results of their study indicated that the weight given by the subjects to each adjective for the overall judgment was found to decrease with each successive adjective. Also, both high and low NC subjects were found to commit a primacy bias, but the extent of this bias committed by high NC subjects was significantly lower than that committed by low NC subjects. Ahlering and Parker also contended that the judges' NC trait might moderate other information process biases such as the base-rate fallacy. However, the findings of the current study do not support their contention.

Similarly, the results of Simonson and Nye (1992) can be used to explain the difference in the results between Ahlering and Parker's study and the current one, which suggested that the existence of the moderating effect of NC on information process biases may depend on the particular characteristics of those biases. NC does not seem to moderate those information processing biases of which the correct response was not known or unlikely to be identified with more thorough information processing. Under-utilisation of base-rate information in making probabilistic

judgments seems to be one such information processing bias. Since only limited research has been done on this area, this explanation is subject to further verification in future studies.

7.2.5 Hypothesis 5

This hypothesis was supported by the current study. This result would lead one to conclude that bank loan officers tend to have more appropriate confidence when they perceive case-specific evidence as being more informative than when they perceive case-specific evidence as being less informative.

This conclusion is consistent with the predictions of the Bayesian rule. As discussed previously in Section 4.3.6 of Chapter IV, the Bayesian rule stipulates that although base-rate information is always relevant, its impact on the normative probability assessment decreases as case-specific evidence becomes more informative. Specifically, when case-specific evidence is highly informative, base-rate information has a lesser impact on the normative probability than when case-specific evidence is highly uninformative.

This conclusion is also consistent with the accounting literature that base-rate information was under-utilised among accounting experts and auditors in making probabilistic judgments in most of the studies (Swieringa *et al.*, 1976; Joyce and Biddle, 1981b; Johnson, 1983; Holt, 1987). Previous psychology studies also indicated that for an event with a low base rate, subjects' probabilistic judgments were found to be overconfident (Dunning *et al.*, 1990; Vallone *et al.*, 1990; Griffin and Tversky, 1992). Therefore, if base-rate information is not properly used by subjects when they perceive case-specific evidence as being less informative, they will have more overconfidence than when they perceive case-specific evidence as being

more informative. This is because under-utilisation of base-rate information has less impact on their judgments when case-specific evidence is more informative than when it is less informative. The result obtained from testing this hypothesis in the current study supports this contention.

The above finding, however, seems to be inconsistent with the findings in psychology that people were found to under-utilise base-rate information when they perceived case-specific evidence as being informative. However, they were found to use base-rate information more properly when they perceived case-specific evidence as being uninformative (e.g., Ginossar and Trope, 1980). Johnson's (1983) findings on his subjects' going-concern judgments throw some light on the conclusion of testing this hypothesis in the current study. He found that when his subjects perceived case-specific evidence as being less informative, they tended to use the given base-rate information more, although still far away from the optimal use, than they did when they perceived case-specific evidence as being more informative.

Although Johnson's findings were in line with previous psychology studies (such as Ginossar and Trope), his findings also suggested that people's tendency to use base-rate information more when they perceive case-specific evidence as being less informative is not sufficient for them to avoid more overconfidence than when they perceive case-specific evidence as being more informative. Only when they perceive case-specific evidence as being less informative and properly use base-rate information, will they not have more overconfidence than when case-specific evidence is perceived as being more informative. However, the findings of the current study are still of an exploratory nature and further research on this specific relationship is much warranted.

7.2.6 Overall Conclusions

On the basis of the findings of the current study, one can conclude that bank loan officers tend to be overconfident when predicting the probabilities of firms being in financial distress. Moreover, it is weakly supported that bank loan officers who are given the more relevant base-rate information tend to have less overconfidence than those who are given the less relevant base-rate information. In addition, bank loan officers who perceive case-specific evidence as being more informative are expected to have less overconfidence than those who perceive case-specific evidence as being less informative. However, the NC trait of a bank loan officer has no significant impact on the extent of his/her overconfidence, nor does it have any significant moderating effect on the relation between the relevance of base-rate information and the appropriateness of bank loan officers' confidence.

7.3 Implications for Theory

The findings of the current study can contribute to both BDT and BDR in accounting in several ways. First, bank loan officers were found to be overconfident when predicting the probabilities of firms being in financial distress. Since no study has been found to examine the appropriateness of bank loan officers' confidence by using real subjects in this prediction task, the current study is the first attempt to address this issue and contributes to understanding the prediction performance of this type of experts as being measured by the appropriateness of their confidence.

Second, the current study attempted to determine the effects of the relevance of base-rate information, the perceived informativeness of case-specific evidence, and the bank loan officers' NC trait on the appropriateness of their confidence. The results of testing the hypotheses related to these relationships indicated that the perceived

informativeness of case-specific evidence had significant main effects on the appropriateness of bank loan officers' confidence, and the relevance of base-rate information was weakly supported to affect the appropriateness of bank loan officers' confidence. These findings contribute to BDR in accounting by identifying these two variables as the factors affecting the appropriateness of bank loan officers' confidence. Therefore, the current study makes distinct contributions to the body of knowledge in its immediate research discipline.

Third, the current study also contributes to BDT in psychology by generalising some of the BDT's findings to other decision-making tasks. The results of the current study weakly supported the premise that bank loan officers tend to have less overconfidence when they are provided with the more relevant base-rate information, than when they are provided with the less relevant base-rate information. The results of the current study also suggest that bank loan officers tend to have less overconfidence when they perceive case-specific evidence as being more informative, than when they perceive case-specific evidence as being less informative. Since no studies in either accounting or psychology have examined the impacts of these two factors on people's probabilistic judgment performance as measured by the appropriateness of their confidence, these findings make distinct contributions to the body of knowledge in the parent research discipline of the current study in terms of theory development, and provide some insights into BDT research for psychology researchers to do further research.

Fourth, since the bank loan officers' NC trait was found to have no significant effect on the degree of their overconfidence, it implies that an increase in cognitive effort will not improve the appropriateness of bank loan officers' confidence when they are required to make similar probabilistic judgments. Therefore, factors, such as accountability and provision of financial incentives, that promote cognitive effort are unlikely to improve the appropriateness of bank loan officers' confidence in similar

tasks. The current study provides a foundation on which further studies investigating the impact of the judges' NC trait on their performance in other prediction tasks can be conducted.

7.4 Implications for Practice

The current study provides several implications for the practice of a variety of users and providers of financial statement information. First, the current study found that bank loan officers tend to be overconfident. In view of the serious adverse effects of inappropriate confidence among bank loan officers as discussed in Chapter I, every effort should be devoted to bringing their attention to this phenomenon and the major factors affecting the appropriateness of their confidence. For example, bank loan officers should be notified that they might tend to be overconfident, especially when they perceive case-specific evidence as being less informative. This information can be useful for bank loan officers to adjust their judgment approach and estimations to improve their prediction performance.

The current study also provides useful input for information systems professionals to design better information systems for bank loan officers. First, information systems designers should provide the more relevant base-rate information to bank loan officers. Second, information systems professionals can also provide appropriate warning signals and advice in the information systems designed for bank loan officers to guard against their inherent limitations and biases in handling probabilistic judgments. These signals would serve to bring their attention to the effects of the relevance of base-rate information and the perceived informativeness of case-specific evidence on their probabilistic judgments. The systems may also be designed so that they can give advice on the direction and the extent of adjustment necessary for achieving more appropriate confidence. Third, another approach to improving bank

loan officers' judgments, other than providing warning signals and leaving bank loan officers to make their own adjustments, is to adjust their probabilistic judgments or final lending decisions automatically by a carefully designed expert system.

Finally, the current study can help trainers design better training programmes for bank loan officers. As mentioned previously, attaining more appropriate confidence is a teachable and learnable skill (Russo and Schoemaker, 1992). By knowing the major factors affecting the appropriateness of bank loan officers' confidence, a better training programme can be designed and conducted to cope with their needs and to reduce the degree of their inappropriate confidence.

7.5 Limitations of the Study

It is very difficult for a single study such as the current one to firmly establish a new theory. Additional follow-up experiments which address some potential limitations of the current study would be desirable. Despite their potential usefulness, these follow-up experiments have not been conducted in view of the difficulty of obtaining similar type and number of subjects in Hong Kong. Future studies should be designed to resolve these potential limitations.

The first limitation is concerned with the subjects of the current study. Since the subjects were not selected randomly, but on the basis of availability and their willingness to participate in this research, it is unknown whether the conclusions drawn from the current study were biased by this mode of subject selection. Also, since the purpose of the current study is theory development and testing, the subjects were intentionally drawn from one major banking group in Hong Kong (consisting of 14 different independent banks) in order to increase the internal validity of the findings. However, the generalisation of these findings to other bank loan officers

outside this banking group should be made with caution.

The second potential limitation is related to the data collection approach adopted by the current study, which used a field experiment by an individual interview as the method to collect the necessary data. Although every effort had been devoted to ensuring that all the interviews were administered in the same manner with minimal biases, these interviews were conducted at different times and locations. However, it is believed that the effects of these uncontrollable factors would be rather minimal.

The third limitation is pertinent to measuring the perceived informativeness of case-specific evidence in the current study. As this variable could not be manipulated in the experiments, it was determined according to the subjects' perceived values of their estimated financial distress likelihood. Although a similar method of operationalising this variable was also adopted by Johnson (1983) in a study of auditors' going-concern judgments, it is still not clear whether the use of this measurement approach would induce any self-selection bias. This potential bias suggests that bank loan officers who perceive the given corporate financial profiles as being less informative may tend to have more overconfidence or vice versa. However, since the ten given corporate financial profiles were classified into both the "less informative" and the "more informative" groups, even though the number of profiles being classified into each of these two groups by each subject might not be exactly the same, this practice should lend some comfort to the reliability of the findings on this variable.

Fourth, the amount of total debt appeared in each financial profile of the experiment instrument was the sum of short-term loan and long-term loan. This definition of "total debt" specifically excluded other short-term and long-term liabilities. However, this definition was not provided in the instrument. It was unknown whether subjects had been confused by this term. However, since all the subjects

used the same information about these two debt ratios in both tasks of the experiment, the unspecified definition of total debt is believed not to have any significant effects on the results of the current study.

The fifth limitation is the possible effects of reward structure (or loss function) on the appropriateness of bank loan officers' confidence during the experiments. Reward structure (i.e., the rewards for correct decisions and the penalties for incorrect ones) was not controlled in the current study. In practice, the extent of appropriate confidence among bank loan officers might depend on the loss functions imposed on their overconfidence or underconfidence. The results could be different from real situations if the subjects had taken such reward structure into consideration when making their judgments. Therefore, the potential effect of this variable on the results of the current study is unknown and taken as a random background variable. Although the experiments of the current study were designed and conducted as realistically as possible, the lack of control of this possible effect might be a potential limitation of the current study.

The sixth limitation is connected with the potential change in the subjects' cognitive process in performing the two experiment tasks. In Task 1, the subjects were asked to assess the likelihood that a firm would be in financial distress in the coming year. In Task 2 however, the subjects were asked to estimate the probability that each of the sample firms was among one of the 30 firms in financial distress in the coming year. Although the wordings of the question in Task 2 were not exactly the same as those of the question in Task 1, both questions requested the subjects to make similar probability predictions. Therefore, the subjects were not expected to use a significantly different cognitive process when they answered the question in Task 2. However, since the possibility of this change in the cognitive process among the subjects could not be ruled out completely, such possible effects were mentioned as a potential limitation of the current study. Future studies in this area should improve

the experimental design in order to eliminate this potential limitation.

Finally, the last limitation is the different results on the second hypothesis obtained from the two analyses conducted by the current study. While the unbalanced ANOVA revealed a strong support for the existence of the effects of the relevance of base-rate information on the appropriateness of bank loan officers' confidence, the repeated measures ANOVA did not indicate such effects. In view of the difference in these results, the second hypothesis can only be weakly supported. Therefore, the conclusion drawn on this hypothesis should be interpreted with caution.

7.6 Recommendations for Further Research

Besides resolving the above potential limitations, several recommendations for further research can be made. First, the current study was concerned only with predicting the probabilities of firms being in financial distress. The impact of overconfidence on the final lending decisions was not addressed. Further research may examine this relationship in order to provide additional insights into the theories in this line of research.

The second recommendation deals with the limitation of the subject selection method adopted in the current study as discussed in Section 7.5. The current study selected bank loan officers from only one major banking group in Hong Kong. Although this banking group consists of 14 different individual banks, further research may investigate the appropriateness of bank loan officers' confidence outside this banking group. This may help reduce any possible sampling bias of selecting all the subjects from one banking group. This may also help compare the confidence levels among the bank loan officers from different banking groups and their relationships with the specific characteristics of each group. The findings of different studies could then be

compared, and the collective findings could add additional reliability to the theories. When the judgments of other bank loan officers are examined, corporate policy and cultural factors may also be taken into consideration.

The final recommendation addresses specifically to the scope of the current study, which focused only on the judgments of individual bank loan officers. The effects of the interactions among bank loan officers in a group or committee on the appropriateness of their confidence should be an interesting topic for further research. When the group judgments of bank loan officers are investigated, social psychology factors, such as accountability, may also be taken into consideration.

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APPENDIX A :

EXPERIMENT INSTRUMENT (IN ENGLISH)

School of Accountancy
The Chinese University of Hong Kong

A STUDY ON HOW BANK LOAN OFFICERS MAKE JUDGMENTS IN PREDICTING FINANCIALLY DISTRESSED FIRMS

Research Questionnaire

I. Introduction

Thank you for participating in this study which is supported by the School of Accountancy, the Faculty of Business Administration, The Chinese University of Hong Kong. The major objective of this study is to investigate how bank loan officers make judgments in predicting financially distressed firms. A financially distressed firm is defined in this study as an industrial firm that has been suspended or de-listed from listing on the Stock Exchange of Hong Kong due to financial difficulty.

Your participation in this study is very important for yourself as well as bank loan officers in Hong Kong in general. After this study, you will know how well you predict firms in financial distress. You will also contribute to the understanding of the decision behaviour of bank loan officers in Hong Kong. If you are interested in the results of this study, we are more than willing to send you a copy of the report. Please put a "√" below if you would like to have such a report:

|___| Please send me a copy of the report for this study.

After this short introduction, we now proceed to the questionnaire with details described in the next section.

II. Assessing how likely a sample firm will be in financial distress

Ten (10) industrial firms publicly listed in Hong Kong during the period of 1986 to 1992 were selected for this study. These firms included both financially distressed and healthy firms during the period. The corporate financial profile of a financially distressed firm was extracted from its annual report one year before it was in financial distress, while the corporate financial profile of a healthy firm was extracted from one of its annual reports selected randomly from the said period. These corporate financial profiles are independent of each other and will be presented to you later in random order.

Nine (9) financial ratios are presented in random order in each corporate financial profile. Based on the corporate financial profile provided, please estimate how likely it is the given firm will be in financial distress in the coming year. Please keep in mind that not all these nine (9) financial ratios are necessarily useful for predicting financial distress. You may use as few as one, or as many as all these financial ratios. Now, let us examine these corporate financial profiles, each of which will be presented on a separate page starting from the next page.

THE FINANCIAL PROFILE OF COMPANY A

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	5.76
2. Quick Assets# to Total Assets	0.16
3. Working Capital* to Total Shareholders' Equity	0.14
4. Total Debt to Total Shareholders' Equity	0.16
5. Total Debt to Total Assets	0.16
6. Net Sales to Cash	0.05
7. Net Sales to Total Assets	0.01
8. Net Sales to Total Shareholders' Equity	0.01
9. Net Income to Total Assets	0.32

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable
* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY B

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	2.35
2. Quick Assets# to Total Assets	0.34
3. Working Capital* to Total Shareholders' Equity	0.66
4. Total Debt to Total Shareholders' Equity	0.82
5. Total Debt to Total Assets	0.36
6. Net Sales to Cash	356.11
7. Net Sales to Total Assets	0.24
8. Net Sales to Total Shareholders' Equity	0.56
9. Net Income to Total Assets	-0.94

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY C

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	2.52
2. Quick Assets# to Total Assets	0.51
3. Working Capital* to Total Shareholders' Equity	0.56
4. Total Debt to Total Shareholders' Equity	0.18
5. Total Debt to Total Assets	0.12
6. Net Sales to Cash	6.35
7. Net Sales to Total Assets	0.17
8. Net Sales to Total Shareholders' Equity	0.26
9. Net Income to Total Assets	0.04

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY D

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	3.72
2. Quick Assets# to Total Assets	0.13
3. Working Capital* to Total Shareholders' Equity	0.23
4. Total Debt to Total Shareholders' Equity	0.09
5. Total Debt to Total Assets	0.08
6. Net Sales to Cash	7.29
7. Net Sales to Total Assets	0.60
8. Net Sales to Total Shareholders' Equity	0.65
9. Net Income to Total Assets	-0.13

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY E

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	1.64
2. Quick Assets# to Total Assets	0.27
3. Working Capital* to Total Shareholders' Equity	0.13
4. Total Debt to Total Shareholders' Equity	0.15
5. Total Debt to Total Assets	0.12
6. Net Sales to Cash	0.31
7. Net Sales to Total Assets	0.04
8. Net Sales to Total Shareholders' Equity	0.05
9. Net Income to Total Assets	-0.07

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY F

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	2.35
2. Quick Assets# to Total Assets	0.17
3. Working Capital* to Total Shareholders' Equity	0.11
4. Total Debt to Total Shareholders' Equity	0.10
5. Total Debt to Total Assets	0.09
6. Net Sales to Cash	1.31
7. Net Sales to Total Assets	0.12
8. Net Sales to Total Shareholders' Equity	0.13
9. Net Income to Total Assets	-0.08

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY G

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	0.40
2. Quick Assets# to Total Assets	0.04
3. Working Capital* to Total Shareholders' Equity	-0.47
4. Total Debt to Total Shareholders' Equity	0.06
5. Total Debt to Total Assets	0.03
6. Net Sales to Cash	48.37
7. Net Sales to Total Assets	0.28
8. Net Sales to Total Shareholders' Equity	0.50
9. Net Income to Total Assets	-0.27

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY H

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	0.82
2. Quick Assets# to Total Assets	0.31
3. Working Capital* to Total Shareholders' Equity	-0.53
4. Total Debt to Total Shareholders' Equity	0.50
5. Total Debt to Total Assets	0.12
6. Net Sales to Cash	21.99
7. Net Sales to Total Assets	0.61
8. Net Sales to Total Shareholders' Equity	2.66
9. Net Income to Total Assets	0.03

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY I

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	0.82
2. Quick Assets# to Total Assets	0.05
3. Working Capital* to Total Shareholders' Equity	-0.04
4. Total Debt to Total Shareholders' Equity	0.00
5. Total Debt to Total Assets	0.00
6. Net Sales to Cash	166.16
7. Net Sales to Total Assets	0.26
8. Net Sales to Total Shareholders' Equity	0.31
9. Net Income to Total Assets	0.13

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY J

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	1.10
2. Quick Assets# to Total Assets	0.44
3. Working Capital* to Total Shareholders' Equity	0.12
4. Total Debt to Total Shareholders' Equity	0.81
5. Total Debt to Total Assets	0.38
6. Net Sales to Cash	2.01
7. Net Sales to Total Assets	0.76
8. Net Sales to Total Shareholders' Equity	1.63
9. Net Income to Total Assets	-0.08

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

(For Control Group Only)

III. Estimating how likely a sample firm is among one of the financially distressed firms

In this second round of the judgment exercise, the following additional information are given to you:

The given ten (10) corporate financial profiles were in fact selected randomly from 100 firms of which 30 firms have been in financial distress and 70 firms have not been in financial distress.

Based on this additional information, for each corporate financial profile, please estimate how likely it is the firm is among one of the 30 financially distressed firms. To help you to answer the second question, you will be given back your estimation in the first round of how likely it is each firm will be in financial distress in the coming year on the basis of the firm's financial profile.

(For Experimental Group Only)

III. Estimating how likely a sample firm is among one of the financially distressed firms

In this second round of the judgment exercise, the following additional information are given to you:

The given ten (10) corporate financial profiles were in fact selected randomly from a sample of 100 firms in an industry of which 30 firms have been in financial distress and 70 firms have not been in financial distress. This industry was regarded as risky in terms of very keen competition in that industry and highly fluctuating demands for its products.

Based on this additional information, for each corporate financial profile, please estimate how likely it is the firm is among one of the 30 financially distressed firms. To help you to answer the second question, you will be given back your estimation in the first round of how likely it is each firm will be in financial distress in the coming year on the basis of the firm's financial profile.

THE FINANCIAL PROFILE OF COMPANY A

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	5.76
2. Quick Assets# to Total Assets	0.16
3. Working Capital* to Total Shareholders' Equity	0.14
4. Total Debt to Total Shareholders' Equity	0.16
5. Total Debt to Total Assets	0.16
6. Net Sales to Cash	0.05
7. Net Sales to Total Assets	0.01
8. Net Sales to Total Shareholders' Equity	0.01
9. Net Income to Total Assets	0.32

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

2. Please estimate how likely it is the firm with the given corporate financial profile is among one of the 30 financially distressed firms. Please indicate your estimation by a number ranging from 0 % (i.e., certainly the firm is NOT among one of the 30 financially distressed firms) to 100 % (certainly the firm is among one of the 30 financially distressed firms), while 50 % represents indifference.

|___|___|___| %

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable
* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY B

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	2.35
2. Quick Assets# to Total Assets	0.34
3. Working Capital* to Total Shareholders' Equity	0.66
4. Total Debt to Total Shareholders' Equity	0.82
5. Total Debt to Total Assets	0.36
6. Net Sales to Cash	356.11
7. Net Sales to Total Assets	0.24
8. Net Sales to Total Shareholders' Equity	0.56
9. Net Income to Total Assets	-0.94

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

2. Please estimate how likely it is the firm with the given corporate financial profile is among one of the 30 financially distressed firms. Please indicate your estimation by a number ranging from 0 % (i.e., certainly the firm is NOT among one of the 30 financially distressed firms) to 100 % (certainly the firm is among one of the 30 financially distressed firms), while 50 % represents indifference.

|___|___|___| %

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable
* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY C

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	2.52
2. Quick Assets# to Total Assets	0.51
3. Working Capital* to Total Shareholders' Equity	0.56
4. Total Debt to Total Shareholders' Equity	0.18
5. Total Debt to Total Assets	0.12
6. Net Sales to Cash	6.35
7. Net Sales to Total Assets	0.17
8. Net Sales to Total Shareholders' Equity	0.26
9. Net Income to Total Assets	0.04

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

2. Please estimate how likely it is the firm with the given corporate financial profile is among one of the 30 financially distressed firms. Please indicate your estimation by a number ranging from 0 % (i.e., certainly the firm is NOT among one of the 30 financially distressed firms) to 100 % (certainly the firm is among one of the 30 financially distressed firms), while 50 % represents indifference.

|___|___|___| %

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY D

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	3.72
2. Quick Assets# to Total Assets	0.13
3. Working Capital* to Total Shareholders' Equity	0.23
4. Total Debt to Total Shareholders' Equity	0.09
5. Total Debt to Total Assets	0.08
6. Net Sales to Cash	7.29
7. Net Sales to Total Assets	0.60
8. Net Sales to Total Shareholders' Equity	0.65
9. Net Income to Total Assets	-0.13

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

2. Please estimate how likely it is the firm with the given corporate financial profile is among one of the 30 financially distressed firms. Please indicate your estimation by a number ranging from 0 % (i.e., certainly the firm is NOT among one of the 30 financially distressed firms) to 100 % (certainly the firm is among one of the 30 financially distressed firms), while 50 % represents indifference.

|___|___|___| %

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY E

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	1.64
2. Quick Assets# to Total Assets	0.27
3. Working Capital* to Total Shareholders' Equity	0.13
4. Total Debt to Total Shareholders' Equity	0.15
5. Total Debt to Total Assets	0.12
6. Net Sales to Cash	0.31
7. Net Sales to Total Assets	0.04
8. Net Sales to Total Shareholders' Equity	0.05
9. Net Income to Total Assets	-0.07

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

2. Please estimate how likely it is the firm with the given corporate financial profile is among one of the 30 financially distressed firms. Please indicate your estimation by a number ranging from 0 % (i.e., certainly the firm is NOT among one of the 30 financially distressed firms) to 100 % (certainly the firm is among one of the 30 financially distressed firms), while 50 % represents indifference.

|___|___|___| %

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY F

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	2.35
2. Quick Assets# to Total Assets	0.17
3. Working Capital* to Total Shareholders' Equity	0.11
4. Total Debt to Total Shareholders' Equity	0.10
5. Total Debt to Total Assets	0.09
6. Net Sales to Cash	1.31
7. Net Sales to Total Assets	0.12
8. Net Sales to Total Shareholders' Equity	0.13
9. Net Income to Total Assets	-0.08

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

2. Please estimate how likely it is the firm with the given corporate financial profile is among one of the 30 financially distressed firms. Please indicate your estimation by a number ranging from 0 % (i.e., certainly the firm is NOT among one of the 30 financially distressed firms) to 100 % (certainly the firm is among one of the 30 financially distressed firms), while 50 % represents indifference.

|___|___|___| %

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY G

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	0.40
2. Quick Assets# to Total Assets	0.04
3. Working Capital* to Total Shareholders' Equity	-0.47
4. Total Debt to Total Shareholders' Equity	0.06
5. Total Debt to Total Assets	0.03
6. Net Sales to Cash	48.37
7. Net Sales to Total Assets	0.28
8. Net Sales to Total Shareholders' Equity	0.50
9. Net Income to Total Assets	-0.27

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

2. Please estimate how likely it is the firm with the given corporate financial profile is among one of the 30 financially distressed firms. Please indicate your estimation by a number ranging from 0 % (i.e., certainly the firm is NOT among one of the 30 financially distressed firms) to 100 % (certainly the firm is among one of the 30 financially distressed firms), while 50 % represents indifference.

|___|___|___| %

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY H

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	0.82
2. Quick Assets# to Total Assets	0.31
3. Working Capital* to Total Shareholders' Equity	-0.53
4. Total Debt to Total Shareholders' Equity	0.50
5. Total Debt to Total Assets	0.12
6. Net Sales to Cash	21.99
7. Net Sales to Total Assets	0.61
8. Net Sales to Total Shareholders' Equity	2.66
9. Net Income to Total Assets	0.03

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

2. Please estimate how likely it is the firm with the given corporate financial profile is among one of the 30 financially distressed firms. Please indicate your estimation by a number ranging from 0 % (i.e., certainly the firm is NOT among one of the 30 financially distressed firms) to 100 % (certainly the firm is among one of the 30 financially distressed firms), while 50 % represents indifference.

|___|___|___| %

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY I

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	0.82
2. Quick Assets# to Total Assets	0.05
3. Working Capital* to Total Shareholders' Equity	-0.04
4. Total Debt to Total Shareholders' Equity	0.00
5. Total Debt to Total Assets	0.00
6. Net Sales to Cash	166.16
7. Net Sales to Total Assets	0.26
8. Net Sales to Total Shareholders' Equity	0.31
9. Net Income to Total Assets	0.13

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

2. Please estimate how likely it is the firm with the given corporate financial profile is among one of the 30 financially distressed firms. Please indicate your estimation by a number ranging from 0 % (i.e., certainly the firm is NOT among one of the 30 financially distressed firms) to 100 % (certainly the firm is among one of the 30 financially distressed firms), while 50 % represents indifference.

|___|___|___| %

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

THE FINANCIAL PROFILE OF COMPANY J

FINANCIAL RATIO	VALUE
1. Current Assets to Current Liabilities	1.10
2. Quick Assets# to Total Assets	0.44
3. Working Capital* to Total Shareholders' Equity	0.12
4. Total Debt to Total Shareholders' Equity	0.81
5. Total Debt to Total Assets	0.38
6. Net Sales to Cash	2.01
7. Net Sales to Total Assets	0.76
8. Net Sales to Total Shareholders' Equity	1.63
9. Net Income to Total Assets	-0.08

QUESTION:

1. Please estimate how likely it is the firm with the given corporate financial profile will be in financial distress in the coming year. Please indicate your estimation by a number ranging from 0 (i.e., the firm absolutely will NOT be in financial distress in the coming year) to 100 (i.e., the firm absolutely will be in financial distress in the coming year), while 50 represents indifference.

|___|___|___|

2. Please estimate how likely it is the firm with the given corporate financial profile is among one of the 30 financially distressed firms. Please indicate your estimation by a number ranging from 0 % (i.e., certainly the firm is NOT among one of the 30 financially distressed firms) to 100 % (certainly the firm is among one of the 30 financially distressed firms), while 50 % represents indifference.

|___|___|___| %

Quick Assets = Cash + Short-term Marketable Securities + Accounts Receivable

* Working Capital = Current Assets - Current Liabilities

IV. Information processing characteristics test:

The following 18 questions are used to measure your information processing characteristics. Please indicate the degree of agreement or disagreement with each of the statements listed below, by circling a number between +3 and -3: +3 = "strongly agree", +2 = "moderately agree", +1 = "slightly agree", 0 = "neutral", -1 = "slightly disagree", -2 = "moderately disagree", -3 = "strongly disagree":

1. I prefer complex to simple problems.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
2. I like to have the responsibility of handling a situation that requires a lot of thinking.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
3. Thinking is no fun for me.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
4 I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
5. I try to avoid situations where there is likely chance I will have to think in depth about something.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
6. I find satisfaction in thinking hard for long hours.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
7. I only think as hard as I have to.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
8. I prefer thinking about small, daily projects to thinking about long-term ones.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly

9. I like tasks that require little thought once I've learned them	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
10. I like to rely on thinking to make my jobs perfect.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
11. I really enjoy a task that involves coming up with new solutions to problems.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
12. Learning new ways to think doesn't excite me very much.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
13. I prefer my life to be filled with puzzles that I must solve.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
14. The notion of thinking abstractly is appealing to me.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
15. I prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
16. I feel relief rather than satisfaction after completing a task that required a lot of mental effort.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
17. It's enough for me that something gets the job done; I don't care how or why it works.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly
18. I usually stop thinking hard about issues when they do not affect me personally.	+3 strongly	+2	+1	0 neutral	-1	-2	-3 strongly

APPENDIX B :

EXPERIMENT INSTRUMENT (IN CHINESE)

香港中文大學
工商管理學院
會計學院

探討銀行放款從業員如何判斷一間公司會否遇上財政困難

研 究 問 卷

I . 導言：

多謝 你參與這項由香港中文大學工商管理學院會計學院支持的研究。 這項研究的主要目的在於探討銀行放款（信貸）從業員如何判斷一間公司會否遇上財政困難。 在這項研究中，一間有財政困難的公司乃指一間在香港上市的非金融業公司，由於財政出現問題而被香港証券交易所停牌或除牌。

你的參與對這項研究十分重要。 在完成這項研究後， 你可以得知自己在判斷一間公司會否遇上財政困難的準確程度。同時， 你對了解香港銀行放款從業員的決策行爲也作出了供獻。 如果 你有興趣獲得這項研究的結果，請在以下指定的位置內填上"✓"號：

|___| 請寄給我一份研究報告。

在下一節，我們將會詳細解釋和進行這份問卷。

Ⅱ．評估個別公司會否遇上財政困難的可能性：

在這份問卷中，我們抽選了 10 間在 1986 年至 1992 年期間在香港上市的非金融業公司作研究對象。這些公司包括有財政困難和財政健全的公司。我們從財政有困難的公司在財政出現困難之前一年的年報中撰錄其財務資料。而財政健全的公司的財務資料則撰錄自在上述期間內隨機取選的年報。這些公司的財務資料將稍後以隨機方式逐間提供給 你評估。同時，每間公司的財務資料都是獨立的。

同時，每間公司的財務資料內的 9 種財務比率也是以隨機方式編排。請根據每間公司的財務資料，估計該公司會在未來一年內遇到財政困難的可能性。值得留意的是，在評估一間公司會否遇上財政困難時，並非所有獲提供的財務比率均有用。你可根據自己的需要而選取有用的比率。每頁將會提供一間公司的財務資料，現在請開始翻看下頁。

A 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	5.76
2. 速動資產# / 資產總額	0.16
3. 營運資金* / 股東權益總額	0.14
4. 借款總額 / 股東權益總額	0.16
5. 借款總額 / 資產總額	0.16
6. 營業淨值總額 / 現金	0.05
7. 營業淨值總額 / 資產總額	0.01
8. 營業淨值總額 / 股東權益總額	0.01
9. 全年純利(虧損) / 資產總額	0.32

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

|__|__|__|

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

B 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	2.35
2. 速動資產# / 資產總額	0.34
3. 營運資金* / 股東權益總額	0.66
4. 借款總額 / 股東權益總額	0.82
5. 借款總額 / 資產總額	0.36
6. 營業淨值總額 / 現金	356.11
7. 營業淨值總額 / 資產總額	0.24
8. 營業淨值總額 / 股東權益總額	0.56
9. 全年純利(虧損) / 資產總額	—0.94

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

|__|__|__|

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

C 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	2.52
2. 速動資產# / 資產總額	0.51
3. 營運資金* / 股東權益總額	0.56
4. 借款總額 / 股東權益總額	0.18
5. 借款總額 / 資產總額	0.12
6. 營業淨值總額 / 現金	6.35
7. 營業淨值總額 / 資產總額	0.17
8. 營業淨值總額 / 股東權益總額	0.26
9. 全年純利(虧損) / 資產總額	0.04

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

|__|__|__|

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

D 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	3.72
2. 速動資產# / 資產總額	0.13
3. 營運資金* / 股東權益總額	0.23
4. 借款總額 / 股東權益總額	0.09
5. 借款總額 / 資產總額	0.08
6. 營業淨值總額 / 現金	7.29
7. 營業淨值總額 / 資產總額	0.60
8. 營業淨值總額 / 股東權益總額	0.65
9. 全年純利(虧損) / 資產總額	—0.13

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

|__|__|__|

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

E 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	1.64
2. 速動資產# / 資產總額	0.27
3. 營運資金* / 股東權益總額	0.13
4. 借款總額 / 股東權益總額	0.15
5. 借款總額 / 資產總額	0.12
6. 營業淨值總額 / 現金	0.31
7. 營業淨值總額 / 資產總額	0.04
8. 營業淨值總額 / 股東權益總額	0.05
9. 全年純利(虧損) / 資產總額	—0.07

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

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速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

F 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	2.35
2. 速動資產# / 資產總額	0.17
3. 營運資金* / 股東權益總額	0.11
4. 借款總額 / 股東權益總額	0.10
5. 借款總額 / 資產總額	0.09
6. 營業淨值總額 / 現金	1.31
7. 營業淨值總額 / 資產總額	0.12
8. 營業淨值總額 / 股東權益總額	0.13
9. 全年純利(虧損) / 資產總額	—0.08

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

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速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

G 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	0.40
2. 速動資產# / 資產總額	0.04
3. 營運資金* / 股東權益總額	—0.47
4. 借款總額 / 股東權益總額	0.06
5. 借款總額 / 資產總額	0.03
6. 營業淨值總額 / 現金	48.37
7. 營業淨值總額 / 資產總額	0.28
8. 營業淨值總額 / 股東權益總額	0.50
9. 全年純利(虧損) / 資產總額	—0.27

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

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速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

H 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	0.82
2. 速動資產# / 資產總額	0.31
3. 營運資金* / 股東權益總額	—0.53
4. 借款總額 / 股東權益總額	0.50
5. 借款總額 / 資產總額	0.12
6. 營業淨值總額 / 現金	21.99
7. 營業淨值總額 / 資產總額	0.61
8. 營業淨值總額 / 股東權益總額	2.66
9. 全年純利(虧損) / 資產總額	0.03

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

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速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

I 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	0.82
2. 速動資產# / 資產總額	0.05
3. 營運資金* / 股東權益總額	—0.04
4. 借款總額 / 股東權益總額	0.00
5. 借款總額 / 資產總額	0.00
6. 營業淨值總額 / 現金	166.16
7. 營業淨值總額 / 資產總額	0.26
8. 營業淨值總額 / 股東權益總額	0.31
9. 全年純利(虧損) / 資產總額	0.13

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

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速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

J 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	1.10
2. 速動資產# / 資產總額	0.44
3. 營運資金* / 股東權益總額	0.12
4. 借款總額 / 股東權益總額	0.81
5. 借款總額 / 資產總額	0.38
6. 營業淨值總額 / 現金	2.01
7. 營業淨值總額 / 資產總額	0.76
8. 營業淨值總額 / 股東權益總額	1.63
9. 全年純利(虧損) / 資產總額	—0.08

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

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速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

（只提供給第一組研究對象）

III. 估計個別公司成爲其中一間有財政困難的公司之機會率：

在這第二部份的問卷中，我們會進一步提供以下的資料給你：

這份問卷所提供的 10 間公司的財務資料其實是隨機地由 100 間公司中抽出。 這 100 間公司當中，包括 30 間出現了財政困難和 70 間是財政健全的公司。

請根據每間公司的財務資料和上述附加資料，估計該公司會是這 30 間出現了財政困難的公司當中一間的機會率。 爲了幫助 你回答這條問題，我們會發還 你在第一部份根據每間公司的財務資料已經完成的有關這些公司會否遇上財政困難的可能性的估計。

（只提供給第二組研究對象）

III. 估計個別公司成爲其中一間有財政困難的公司之機會率：

在這第二部份的問卷中，我們會進一步提供以下的資料給你：

這份問卷所提供的 10 間公司的財務資料其實是隨機地由同一個行業內的100 間公司中抽出。 這 100 間公司中，包括 30 間出現了財政困難和 70 間是財政健全的公司。 該行業被公認爲高風險。 這些風險包括業內競爭激烈，和市場對業內的產品需求高度不穩定。

請根據每間公司的財務資料和上述附加資料，估計該公司會是這 30 間有財政困難的公司當中一間的機會率。 爲了幫助你回答這條問題，我們會發還 你在第一部份根據每間公司的財務資料已經完成的有關這些公司會否遇上財政困難的可能性的估計。

A 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	5.76
2. 速動資產# / 資產總額	0.16
3. 營運資金* / 股東權益總額	0.14
4. 借款總額 / 股東權益總額	0.16
5. 借款總額 / 資產總額	0.16
6. 營業淨值總額 / 現金	0.05
7. 營業淨值總額 / 資產總額	0.01
8. 營業淨值總額 / 股東權益總額	0.01
9. 全年純利(虧損) / 資產總額	0.32

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

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2. 請根據每間公司財務資料，估計該公司會是從所述行業選取的 100 間公司內的 30 間有財政困難的公司當中一間的機會率。請以 0% 至 100% 中的一個數值表示（ 0% 表示該公司肯定不是這 30 間出現財政困難的公司當中的一間； 100% 表示該公司肯定是這 30 間出現財政困難的公司當中的一間）。而 50% 則表示中立。

|__|__|__| %

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

B 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	2.35
2. 速動資產# / 資產總額	0.34
3. 營運資金* / 股東權益總額	0.66
4. 借款總額 / 股東權益總額	0.82
5. 借款總額 / 資產總額	0.36
6. 營業淨值總額 / 現金	356.11
7. 營業淨值總額 / 資產總額	0.24
8. 營業淨值總額 / 股東權益總額	0.56
9. 全年純利(虧損) / 資產總額	—0.94

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

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2. 請根據每間公司財務資料，估計該公司會是從所述行業選取的 100 間公司內的 30 間有財政困難的公司當中一間的機會率。請以 0% 至 100% 中的一個數值表示（ 0% 表示該公司肯定不是這 30 間出現財政困難的公司當中的一間； 100% 表示該公司肯定是這 30 間出現財政困難的公司當中的一間）。而 50% 則表示中立。

|__|__|__| %

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

C 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	2.52
2. 速動資產# / 資產總額	0.51
3. 營運資金* / 股東權益總額	0.56
4. 借款總額 / 股東權益總額	0.18
5. 借款總額 / 資產總額	0.12
6. 營業淨值總額 / 現金	6.35
7. 營業淨值總額 / 資產總額	0.17
8. 營業淨值總額 / 股東權益總額	0.26
9. 全年純利(虧損) / 資產總額	0.04

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

|__|__|__|

2. 請根據每間公司財務資料，估計該公司會是從所述行業選取的 100 間公司內的 30 間有財政困難的公司當中一間的機會率。請以 0% 至 100% 中的一個數值表示（ 0% 表示該公司肯定不是這 30 間出現財政困難的公司當中的一間； 100% 表示該公司肯定是這 30 間出現財政困難的公司當中的一間）。而 50% 則表示中立。

|__|__|__| %

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

D 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	3.72
2. 速動資產# / 資產總額	0.13
3. 營運資金* / 股東權益總額	0.23
4. 借款總額 / 股東權益總額	0.09
5. 借款總額 / 資產總額	0.08
6. 營業淨值總額 / 現金	7.29
7. 營業淨值總額 / 資產總額	0.60
8. 營業淨值總額 / 股東權益總額	0.65
9. 全年純利(虧損) / 資產總額	—0.13

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

|__|__|__|

2. 請根據每間公司財務資料，估計該公司會是從所述行業選取的 100 間公司內的 30 間有財政困難的公司當中一間的機會率。請以 0% 至 100% 中的一個數值表示（ 0% 表示該公司肯定不是這 30 間出現財政困難的公司當中的一間； 100% 表示該公司肯定是這 30 間出現財政困難的公司當中的一間）。而 50% 則表示中立。

|__|__|__| %

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

E 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	1.64
2. 速動資產# / 資產總額	0.27
3. 營運資金* / 股東權益總額	0.13
4. 借款總額 / 股東權益總額	0.15
5. 借款總額 / 資產總額	0.12
6. 營業淨值總額 / 現金	0.31
7. 營業淨值總額 / 資產總額	0.04
8. 營業淨值總額 / 股東權益總額	0.05
9. 全年純利(虧損) / 資產總額	—0.07

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

|__|__|__|

2. 請根據每間公司財務資料，估計該公司會是從所述行業選取的 100 間公司內的 30 間有財政困難的公司當中一間的機會率。請以 0% 至 100% 中的一個數值表示（ 0% 表示該公司肯定不是這 30 間出現財政困難的公司當中的一間； 100% 表示該公司肯定是這 30 間出現財政困難的公司當中的一間）。而 50% 則表示中立。

|__|__|__| %

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

F 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	2.35
2. 速動資產# / 資產總額	0.17
3. 營運資金* / 股東權益總額	0.11
4. 借款總額 / 股東權益總額	0.10
5. 借款總額 / 資產總額	0.09
6. 營業淨值總額 / 現金	1.31
7. 營業淨值總額 / 資產總額	0.12
8. 營業淨值總額 / 股東權益總額	0.13
9. 全年純利(虧損) / 資產總額	—0.08

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

|__|__|__|

2. 請根據每間公司財務資料，估計該公司會是從所述行業選取的 100 間公司內的 30 間有財政困難的公司當中一間的機會率。請以 0% 至 100% 中的一個數值表示（ 0% 表示該公司肯定不是這 30 間出現財政困難的公司當中的一間； 100% 表示該公司肯定是這 30 間出現財政困難的公司當中的一間）。而 50% 則表示中立。

|__|__|__| %

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

G 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	0.40
2. 速動資產# / 資產總額	0.04
3. 營運資金* / 股東權益總額	—0.47
4. 借款總額 / 股東權益總額	0.06
5. 借款總額 / 資產總額	0.03
6. 營業淨值總額 / 現金	48.37
7. 營業淨值總額 / 資產總額	0.28
8. 營業淨值總額 / 股東權益總額	0.50
9. 全年純利(虧損) / 資產總額	—0.27

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

|__|__|__|

2. 請根據每間公司財務資料，估計該公司會是從所述行業選取的 100 間公司內的 30 間有財政困難的公司當中一間的機會率。請以 0% 至 100% 中的一個數值表示（ 0% 表示該公司肯定不是這 30 間出現財政困難的公司當中的一間； 100% 表示該公司肯定是這 30 間出現財政困難的公司當中的一間）。而 50% 則表示中立。

|__|__|__| %

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

H 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	0.82
2. 速動資產# / 資產總額	0.31
3. 營運資金* / 股東權益總額	—0.53
4. 借款總額 / 股東權益總額	0.50
5. 借款總額 / 資產總額	0.12
6. 營業淨值總額 / 現金	21.99
7. 營業淨值總額 / 資產總額	0.61
8. 營業淨值總額 / 股東權益總額	2.66
9. 全年純利(虧損) / 資產總額	0.03

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

|__|__|__|

2. 請根據每間公司財務資料，估計該公司會是從所述行業選取的 100 間公司內的 30 間有財政困難的公司當中一間的機會率。請以 0% 至 100% 中的一個數值表示（ 0% 表示該公司肯定不是這 30 間出現財政困難的公司當中的一間； 100% 表示該公司肯定是這 30 間出現財政困難的公司當中的一間）。而 50% 則表示中立。

|__|__|__| %

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

I 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	0.82
2. 速動資產# / 資產總額	0.05
3. 營運資金* / 股東權益總額	—0.04
4. 借款總額 / 股東權益總額	0.00
5. 借款總額 / 資產總額	0.00
6. 營業淨值總額 / 現金	166.16
7. 營業淨值總額 / 資產總額	0.26
8. 營業淨值總額 / 股東權益總額	0.31
9. 全年純利(虧損) / 資產總額	0.13

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難）中的一個數值。而 50 則表示中立。

|__|__|__|

2. 請根據每間公司財務資料，估計該公司會是從所述行業選取的 100 間公司內的 30 間有財政困難的公司當中一間的機會率。請以 0% 至 100% 中的一個數值表示（ 0% 表示該公司肯定不是這 30 間出現財政困難的公司當中的一間； 100% 表示該公司肯定是這 30 間出現財政困難的公司當中的一間）。而 50% 則表示中立。

|__|__|__| %

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

J 公司的財務資料

財務比率	數值
1. 流動資產 / 流動負債	1.10
2. 速動資產# / 資產總額	0.44
3. 營運資金* / 股東權益總額	0.12
4. 借款總額 / 股東權益總額	0.81
5. 借款總額 / 資產總額	0.38
6. 營業淨值總額 / 現金	2.01
7. 營業淨值總額 / 資產總額	0.76
8. 營業淨值總額 / 股東權益總額	1.63
9. 全年純利(虧損) / 資產總額	—0.08

問題：

1. 請根據上述公司的財務資料，估計該公司會在未來一年內有財政困難的可能性。 這個估計會是由 0（即該公司肯定不會在未來一年內有財政困難）至 100（即該公司肯定會在未來一年內有財政困難)中的一個數值。而 50 則表示中立。

|__|__|__|

2. 請根據每間公司財務資料，估計該公司會是從所述行業選取的 100 間公司內的 30 間有財政困難的公司當中一間的機會率。請以 0% 至 100% 中的一個數值表示（ 0% 表示該公司肯定不是這 30 間出現財政困難的公司當中的一間； 100% 表示該公司肯定是這 30 間出現財政困難的公司當中的一間）。而 50% 則表示中立。

|__|__|__| %

速動資產 = 現金 + 可轉讓短期投資 + 應收賬款

* 營運資金 = 流動資產 - 流動負債

Ⅴ．個人資料處理特質測驗：

以下 18 條問題是用作測度 你的資料處理特質。 請根據你的實際情況就下列各問題表示同意或不同意的程度。 請使用 +3 至 -3 間的一個數值來表示。 +3 者表示極之同意， +2 者表示相當同意， +1 表示少許同意， 0 表示中立。 -1 表示少許不同意， -2 表示相當不同意， -3 表示極之不同意。

1. 我比較喜愛處理複雜問題多於簡單問題。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

2. 我喜歡負責處理需要多作思考的工作。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

3. 思考對我而言並非樂事。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

4. 我寧願做些不大需要思考的事多於做些挑戰自己思考能力的事。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

5. 我會試圖徊避一些可能會傷透腦筋的情況。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

6. 對於長時間的深入思考，我會感到滿足。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

7. 我只會在迫不得意時才會深入思考。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

8. 我喜歡思考一些日常瑣碎的事，多於喜歡思考一些長遠的事。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

9. 我喜歡處理一些一旦熟習後就不需思考的工作。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

10. 我喜歡倚賴思考來追求自己工作達到完美。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

11. 我喜愛能引發出解決難題新方法的工作。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

12. 學會新的思考方法不會令我感到太大興奮。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

13. 我寧願我的一生充滿必須要解決的疑難。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

14. 我對抽象思考頗感興趣。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

15. 我會選擇一項需要智慧，困難和重要的工作多過一項只是一般重要但卻不需要太多思考的工作。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

16. 當我完成一件需要深思熟慮的工作後，我會感到如釋重負而非只是滿意。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

17. 在我而言，能使一項工作完成已感滿足，再也不管之如何運作或爲何它能運作。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

18. 我通常避免思考一些與我無關的問題。

+3 +2 +1 0 -1 -2 -3
極之同意 中立 極之不同意

APPENDIX C :

STEPWISE LOGIT ANALYSIS RESULTS

Stepwise Logistic Analysis

The LOGISTIC Procedure

Response Variable: Type of Firm
Response Levels: 2
Number of Observations: 39

Explanatory Variable: Financial Ratios
Number of Explanatory Variables: 33

Link Function: Logit

Response Profile

Ordered Value	Type of Firm	Number of Firms
1	Financially Distressed	13
2	Healthy	26

The Potential Explanatory Variables: 33 Financial Ratios.

cash / current liabilities
cash / total assets
cash flows / current liabilities
cash flows / total debt
cash flows / total liabilities
cash flows / total assets
cash flows / sales
current assets / current liabilities
current assets / total assets
current assets / sales

total debt / equity
total debt / total assets
total liabilities / equity
total liabilities / tangible assets

sales / cash
sales / total assets

operating profits / current liab.
earnings before tax / total assets
net income / equity

current liabilities / total debt
current liabilities / equity
current liabilities / total assets
quick assets / total assets
quick assets / sales
quick assets / current liabilities
working capital / sales
working capital / equity

equity / total assets
fixed assets / total assets

sales / working capital

net income / sales
net income / total assets
retained profits / total assets

Stepwise Selection Procedure

Step 0. Intercept entered:

Residual Chi-Square = 37.9732 with 33 DF (p=0.2530)

Step 1. Variable CA_CL (Current Assets to Current Liabilities) entered:

Criteria for Assessing Model Fit

Criterion[1]	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	44.657	.
SC	53.312	47.984	.
-2 LOG L	49.648	40.657	8.991 with 1 DF (p=0.0027)
Score	.	.	5.319 with 1 DF (p=0.0211)

Residual Chi-Square = 34.5180 with 32 DF (p=0.3484)

Step 2. Variable S_CASH (Sales to Cash) entered:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	44.627	.
SC	53.312	49.618	.
-2 LOG L	49.648	38.627	11.021 with 2 DF (p=0.0040)
Score	.	.	5.894 with 2 DF (p=0.0525)

Residual Chi-Square = 32.1793 with 31 DF (p=0.4081)

Step 3. Variable CL_DEBT (Current Liabilities to Total Debts) entered:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	44.103	.
SC	53.312	50.757	.
-2 LOG L	49.648	36.103	13.545 with 3 DF (p=0.0036)
Score	.	.	8.802 with 3 DF (p=0.0320)

Residual Chi-Square = 29.6860 with 30 DF (p=0.4818)

Step 4. Variable DEBT_EQ (Total Debts to Equity) entered:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	43.344	.
SC	53.312	51.662	.
-2 LOG L	49.648	33.344	16.304 with 4 DF (p=0.0026)
Score	.	.	10.894 with 4 DF (p=0.0278)

Residual Chi-Square = 27.9870 with 29 DF (p=0.5186)

Step 5. Variable S_TA (Sales to Total Assets) entered:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	43.643	.
SC	53.312	53.624	.
-2 LOG L	49.648	31.643	18.006 with 5 DF (p=0.0029)
Score	.	.	12.289 with 5 DF (p=0.0310)

Residual Chi-Square = 27.1609 with 28 DF (p=0.5095)

Step 6. Variable EQ_TA (Equity to Total Assets) entered:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	43.615	.
SC	53.312	55.260	.
-2 LOG L	49.648	29.615	20.033 with 6 DF (p=0.0027)
Score	.	.	14.393 with 6 DF (p=0.0255)

Step 7. Variable CL_DEBT (Current Liabilities to Total Debts) is removed:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	43.321	.
SC	53.312	53.302	.
-2 LOG L	49.648	31.321	18.327 with 5 DF (p=0.0026)
Score	.	.	11.570 with 5 DF (p=0.0412)

Residual Chi-Square = 29.3360 with 28 DF (p=0.3956)

Step 8. Variable S_EQ (Sales to Equity) entered:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	44.184	.
SC	53.312	55.829	.
-2 LOG L	49.648	30.184	19.464 with 6 DF (p=0.0034)
Score	.	.	11.634 with 6 DF (p=0.0707)

Residual Chi-Square = 27.2187 with 27 DF (p=0.4520)

Step 9. Variable DEBT_TA (Total debts to Total Assets) entered:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	37.781	.
SC	53.312	51.090	.
-2 LOG L	49.648	21.781	27.867 with 7 DF (p=0.0002)
Score	.	.	11.737 with 7 DF (p=0.1095)

Step 10. Variable EQ_TA (Equity to Total Assets) is removed:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	35.923	.
SC	53.312	47.568	.
-2 LOG L	49.648	21.923	27.725 with 6 DF (p=0.0001)
Score	.	.	11.316 with 6 DF (p=0.0791)

Residual Chi-Square = 19.9447 with 27 DF (p=0.8331)

Step 11. Variable WC_EQ (Working Capital to Equity) entered:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	33.796	.
SC	53.312	47.104	.
-2 LOG L	49.648	17.796	31.853 with 7 DF (p=0.0001)
Score	.	.	13.255 with 7 DF (p=0.0661)

Residual Chi-Square = 19.7186 with 26 DF (p=0.8047)

Step 12. Variable QA_TA (Quick Assets to Total Assets) entered:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	32.277	.
SC	53.312	47.249	.
-2 LOG L	49.648	14.277	35.371 with 8 DF (p=0.0001)
Score	.	.	13.766 with 8 DF (p=0.0881)

Residual Chi-Square = 15.5569 with 24 DF (p=0.9034)

Step 13. Variable CF_TL (Cash Flows to Total Liabilities) entered:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	20.000	.
SC	53.312	36.636	.
-2 LOG L	49.648	0.000	49.648 with 9 DF (p=0.0001)
Score	.	.	14.093 with 9 DF (p=0.1191)

Step 14. Variable CF_TL (Cash Flows to Total Liabilities) is removed:

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	51.648	32.277	.
SC	53.312	47.249	.
-2 LOG L	49.648	14.277	35.371 with 8 DF (p=0.0001)
Score	.	.	13.766 with 8 DF (p=0.0881)

NOTE: Model building terminates because the last variable entered is removed by the Wald statistic criterion.

Summary of Stepwise Procedure

Step	Variable Entered	Variable Removed	Number In	Score Chi-Square	Wald Chi-Square	Pr > Chi-Square
1	CA_CL		1	5.3191	.	0.0211
2	S_CASH		2	2.7220	.	0.0990
3	CL_DEBT		3	1.7936	.	0.1805
4	DEBT_EQ		4	2.1910	.	0.1388
5	S_TA		5	1.6751	.	0.1956
6	EQ_TA		6	1.7975	.	0.1800
7		CL_DEBT	5	.	0.5954	0.4403
8	S_EQ		6	1.4930	.	0.2218
9	DEBT_TA		7	6.1894	.	0.0129
10		EQ_TA	6	.	0.1483	0.7002
11	WC_EQ		7	3.5115	.	0.0609
12	QA_TA		8	2.9355	.	0.0867
13	CF_TL		9	11.7754	.	0.0006
14		CF_TL	8	.	0.00205	0.9639

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	3.2774	2.7431	1.4274	0.2322	.	26.506
CA_CL	1	-5.8875	3.7196	2.5053	0.1135	-5.462574	0.003
QA_TA	1	15.1691	10.3128	2.1635	0.1413	1.428709	999.000
WC_EQ	1	-4.4380	2.3804	3.4761	0.0623	-1.639507	0.012
DEBT_EQ	1	-19.0308	9.2494	4.2334	0.0396	-13.768492	0.000
DEBT_TA	1	71.1277	34.7720	4.1843	0.0408	12.092454	999.000
S_CASH	1	0.0388	0.0284	1.8615	0.1725	2.728692	1.040
S_TA	1	-35.4285	17.8734	3.9291	0.0475	-10.347333	0.000
S_EQ	1	6.3031	3.1038	4.1240	0.0423	8.759359	546.257

Association of Predicted Probabilities and Observed Responses

Concordant = 93.8%	Somers' D = 0.917
Discordant = 2.1%	Gamma = 0.957
Tied = 4.1%	Tau-a = 0.418
(338 pairs)	c = 0.959

Classification Table

Prob Level	Correct Event	Correct Non-Event	Incorrect Event	Incorrect Non-Event	Percentages Correct	Sensi-tivity[2]	Speci-ficity[3]	False POS[4]	False NEG[5]
0.670	7	22	4	6	74.4	53.8	84.6	36.4	21.4

[1] AIC is Akaike Information Criterion, SC is Schwartz Criterion, -2 LOG L is -2 Log Likelihood statistic, and Score is score statistics.

[2] Sensitivity is the proportion of firms in financial distress that are correctly predicted to be financial distress.

[3] Specificity is the proportion of healthy firms that are correctly predicted to be non-healthy.

[4] The false positive rate is the proportion of firms in financial distress responses that are incorrectly predicted to be healthy.

[5] The false negative rate is the proportion of healthy that are incorrectly predicted to be financial distress.